

Travelling towards 2050:

Climate change, storytelling and the future of travel

Jean Marguerite Fletcher

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Abstract

Climate change is a serious threat that is expected to have grave consequences for humans and ecosystems. Current travel (both daily commuting and holiday tourism) is a significant contributor to climate change. Therefore, travel systems must change if the severe impacts of climate change are to be minimised. The perception that climate change will primarily affect the distant future has been identified as a barrier to mitigating climate change. Since humans have difficulty visualising distant futures, individuals may struggle to picture alternative, low carbon futures. The science communication literature proposes that story may be able to help address these challenges.

This thesis addresses the literature's call for more empirical research investigating story as a tool for science communication. In this instance, the context involves communicating about low carbon futures by exploring participants' perceptions of travel in the year 2050 and how these perceptions change after reading a story intervention. The research examined whether participants' expectations of travel in the year 2050 were: i) consistent with the notion of a low carbon mobility future and ii) related to their levels of climate change concern. It also investigated whether temporal distance influenced individual's levels of climate change concern. Next, this thesis explored whether story could help individuals visualise the distant future and whether story could influence participants' expectations of travel in 2050 to make them more consistent with the idea of a low carbon mobility future.

In order to gain a holistic understanding of the issue, a pragmatic, mixed methods approach was adopted. Both quantitative and qualitative data were collected. Quantitative data were analysed using descriptive statistics and nonparametric statistics. Thematic coding was used to analyse the qualitative data. Data were collected in 2016 through two online surveys. The Temporal Distance Survey targeted the American general public, surveying residents a few weeks before the 2016 presidential election (N = 1071). The influence of temporal distance on views about climate change was explored through participants' self-reported ability to visualise the year 2050, their optimism and their attitudes towards technology. The Story Survey targeted younger, well-educated participants who reported high levels of concern about climate change to determine whether a cohort that would be expected to be thinking about more sustainable travel in the future did, in fact, hold views consistent with low carbon mobility. The Story Survey provided 401 useable responses regarding expectations of future travel, 350 which could also be used to examine the influence of story. Participants in the Story Survey read either a short narrative style story intervention (~1500 words, n = 167) or a fictional expository style textbook intervention (~500 words, n = 183).

In the Temporal Distance survey, 44% of participants stated that they were very concerned about climate change compared to 66% of participants in the Story Survey. Despite being concerned, participants did not necessarily associate future travel with low carbon mobility. Only 28% of the American general public in the Temporal Distance Survey and 43% of participants in the Story Survey (a climate concerned cohort) mentioned low carbon mobility options when first asked to describe travel in the year 2050. They also expressed many expectations of future travel that could work to perpetuate current high carbon systems. Expectations of low carbon future travel were related to levels of climate change concern as participants who reported higher levels of concern about climate change were more likely to mention low carbon mobility when describing travel in the year 2050 in both the Temporal Distance Survey and Story Survey.

The Temporal Distance Survey found that participants' perceived ability to visualise temporal distance was not significantly correlated with their level of concern about climate change. In terms of the influence of story, participants said it was difficult to picture the year 2050; however, reading either the story intervention or the textbook intervention improved self-reported ability to visualise the year 2050. Participants' descriptions of travel in the year 2050 also became more story consistent (i.e. more reflective of having transitioned to low carbon mobility systems) after reading either the story or textbook intervention. However, the textbook intervention was more effective at changing participants' expectations, possibly due to a clearer cause and effect explanation in the textbook intervention.

This thesis provides a snapshot of people's perceptions of future travel at a potential turning point in history. Despite being concerned about climate change the majority of participants were not thinking about how mobility systems need to change in order to meet climate change mitigation goals. This thesis contributed an empirical test of previous claims that story could be an effective tool for communicating about climate change. This thesis found story can help people visualise alternative low carbon futures, get them to think about future travel, and suggests story may be useful for stimulating discussion. This research demonstrates the potential of story. Science communicators should continue exploring how story can be used to facilitate the urgent and overdue transition to a low carbon economy, by examining potentially important factors affecting persuasion including identity and narrative empathy as well as strategies for changing behaviour such as description of actionable pathways.

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Abbreviations

ELM: Elaboration Likelihood Model

EPA: Environmental Protection Agency

EV: Electric vehicle

GHG: Greenhouse gas

HEV: Hybrid vehicle

IMSC: Integrated Model of Science Communication

IPCC: Intergovernmental Panel on Climate Change

PHEV: Plug in hybrid vehicles

TPB: Theory of Planned Behaviour

TTM: Transtheoretical Model of Behaviour (Cycle of Change Model)

Glossary

Affect — positive or negative emotions.

Affective heuristics — a mental shortcut which draws on emotions when making decisions.

Alternative facts — “[statements] intended to contradict another more verifiable, but less palatable, statement” (Collins English Dictionary, 2018, par. 2). A synonym of lies.

Anthropogenic — resulting from human activity.

Climate change — “a large-scale, long-term shift in the planet's weather patterns or average temperatures” (Met Office, 2018, par. 1).

Climate change mitigation — involves reducing the amount of greenhouse gas emissions in the atmosphere in order to limit the severity of climate change. Climate change mitigation is often compared to *climate change adaptation* which tries to compensate and adjust for the consequences of climate change (Klein, Schipper, & Dessai, 2005).

Cognitive dissonance — occurs when an individual obtains new information (in the form of knowledge, feelings, behaviours) that is internally inconsistent with their existing views.

Deductive reasoning — data are tested against a known theory or predetermined categories.

Eco-efficiency — decrease carbon emissions through technological advances.

Entertainment education — media and entertainment that intentionally embeds educational messages into the storyline.

Expository text — texts that provide information to explain concepts (explanatory texts).

General public — includes: “industry, the academic community, government, communicators (including science communicators, journalists and other members of the media), educators, and opinion-makers, plus other sectors and interest groups. For example, school children and charity workers” (Burns, O’Conner & Stocklmayer, 2003, p. 184).

Geoengineering — refers to technology that can intentionally manipulate the earth’s climate.

Greenhouse gases (GHGs) — “gases that trap heat in the atmosphere” (EPA, 2018, par 1). Carbon dioxide, methane, nitrous oxide and fluorinated gases are all greenhouse gases.

Inductive reasoning — theories are generated from the data without having a theory or categories identified ahead of time.

Interested public — “composed of people who are interested in but not necessarily well informed about science and technology” (Burns et. al, 2003, p. 184).

Moral norms — an individual’s perceived moral responsibility to engage or refrain from participating in a behaviour.

Narrative — occurs when someone/thing (i.e. character) encounters a series of events over a certain timeframe as told by a narrator.

Negative emissions technologies— technologies intentionally remove carbon dioxide from the atmosphere (Fuss et al., 2014)

Optimism bias — when an individual believes that their future will be better than their peers even though statistically and realistically it probably won't be.

Persuasive communication — “any message that is intended to shape, reinforce or change the responses of another, or others” (Stiff & Mongeau, 2003, p. 4).

Public — “every person in society” (Burns et al., 2003, p. 184).

Qualitative methodology — attempts to interpret meaning and gain an in-depth understanding of attitudes, behaviours and lived experiences.

Quantitative methodology — uses statistical tests to examine the relationship between variables or test a hypothesis.

Science communication — “the use of appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science (the vowel analogy):

Awareness, including familiarity with new aspects of science

Enjoyment or other affective responses, e.g. appreciating science as entertainment or art

Interest, as evidenced by voluntary involvement with science or its communication

Opinions, the forming, reforming, or confirming of science-related attitudes

Understanding of science, its content, processes, and social factors.

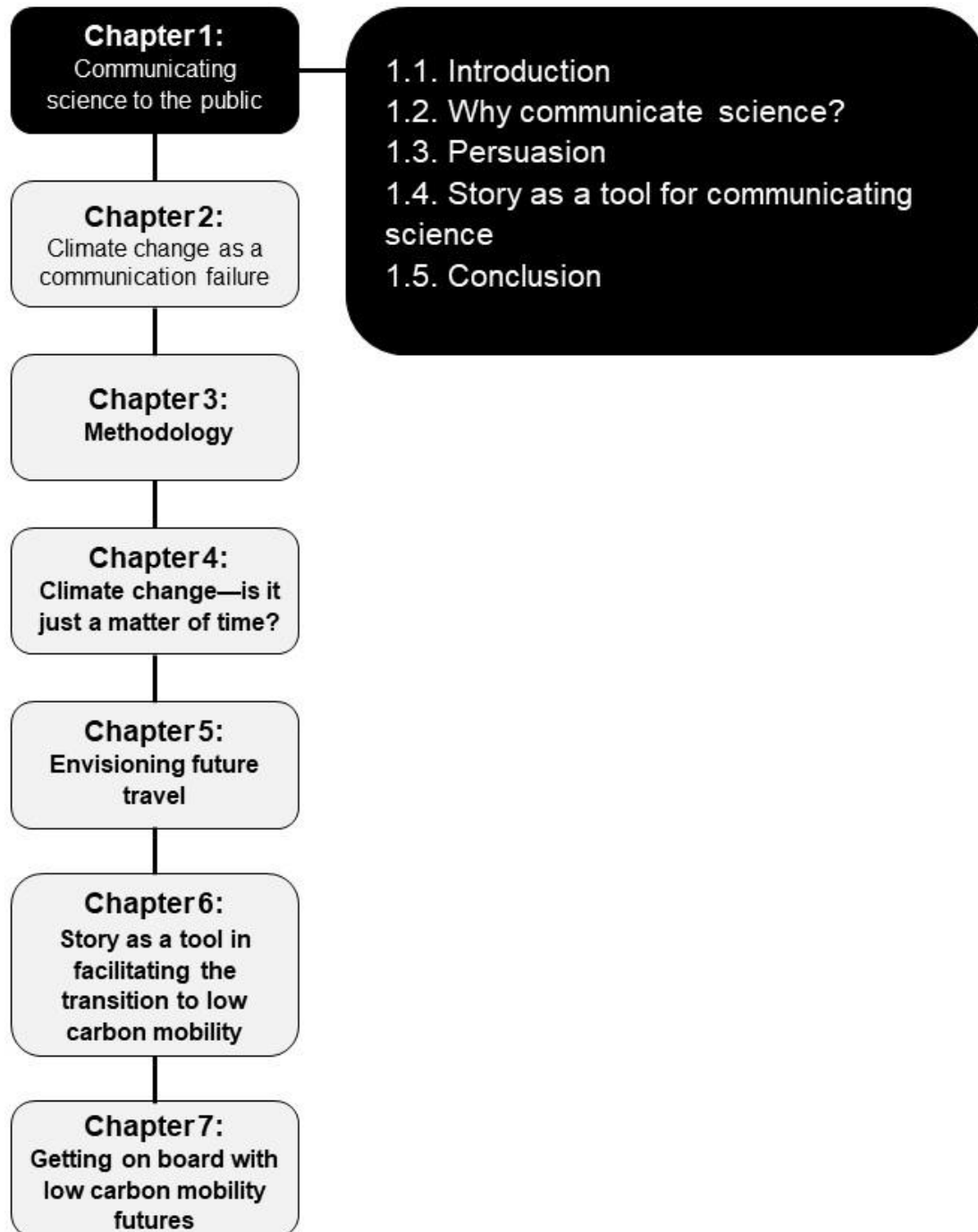
Science communication may involve science practitioners, mediators, and other members of the general public, either peer-to-peer or between groups” (Burns et al., 2003, p. 191).

Social norms — “rules and standards that are understood by members of a group and that guide and/or constrain social behaviour without the force of laws” (Cialdini & Trost, 1998, p. 152).

Sustainable consumption — with respect to climate change it involves lowering emissions by “changing consumption patterns, and reducing throughput of products and services” (Hall, 2016, p. 98)

Techno-institutional complex — the idea that technological systems and institutions (both private and governmental) can be intimately inter-linked, and co-evolve together creating a positive feedback loop that works to re-enforce their system as the dominant system and exclude other technological systems even when other systems are superior.

Chapter 1: Communicating science to the public



The disturbing truth about science communication is that we have theories and ways of delivering messages that really are like putting a candle to the dark, as Carl Sagan would say. We aren't sure what will work, when, or how much. But for all that uncertainty, that doesn't mean we shouldn't try. (Hill, 2014, par. 13)



1.1. Introduction

In his plenary speech at the 2015 World Economic Forum Ban Ki-moon, the Secretary General of the United Nations, stated that “We are the ... last generation that can take steps to avoid the worst impacts of *climate change* (United Nations, 2015a, par. 18).” His statement reiterates the urgency required to minimise the damage climate change is expected to inflict. According to the Intergovernmental Panel on Climate Change’s (IPCC) 2014 report these impacts would negatively affect both the environment (e.g. ecosystem destruction, species extinction) and humans (e.g. crop loss, human illness, population displacement). Unfortunately, human systems — including the way people travel — contribute to climate change (Sims et al., 2014). The ratification of the 2015 Paris Agreement suggests that the world would like to mitigate climate change; however, it is unclear whether individuals expect society to transition to the low carbon lifestyles that are necessary to meet the *climate change mitigation* goals stated in the Paris Agreement.

Despite decades of communication about the threat of climate change, the problem continues to worsen (IPCC, 2014). One challenge with communicating about climate change is that some people think of climate change as a future problem (Carmi & Bartal, 2014; Leiserowitz, 2006; Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; Wang, Leviston, Hurlstone, Lawrence, & Walker, 2018). This association may affect how people judge climate change risk (Carmi & Bartal, 2014; Leiserowitz, 2006; van der Linden, Maibach, & Leiserowitz, 2015) and their willingness to engage in climate change mitigation (Lorenzoni et al., 2007). It may also be hard for people to imagine what a low carbon future would entail as people have difficulty visualising distant futures (Howarth, 2017; Tonn, Hemrick, & Conrad, 2006). Helping individuals visualise low carbon futures is an important step to transitioning away from current high carbon systems.

This first chapter lays out a case for a different approach for communicating science, arguing that story should be considered as a tool for *science communication*. It begins by discussing why science is communicated to the *public* and whether persuasion is ethical. The

chapter goes on to explore the characteristics of story that could influence the decision making process.

1.2. Why communicate science?

There are several reasons commonly used to argue the importance of communicating science to the public (Burns, O'Connor, & Stocklmayer, 2003; Sturgis & Allum, 2004), i.e. “every person in society” (Burns et al., 2003, p. 184). Two motivations — the argument that scientists have the responsibility to give back to the public and that science should be appreciated for science’s sake as an important part of a modern society’s culture (Stocklmayer & Bryant, 2012) — fall outside the scope of this thesis. The focus of this study is how science communication can affect an individual’s attitudes and perceptions and how this, in turn, influences their decision making process. The other predominant argument for why science should be communicated to the public centres around the idea that an understanding of scientific knowledge will help individuals make more informed decisions in their personal and political lives. This is important as these decisions will impact future generations.

It is argued that since individuals encounter science in their daily lives, knowing about science may help them navigate their daily routine (Stocklmayer & Bryant, 2012). For an individual to make an informed decision regarding whether to bicycle or drive a petrol vehicle to work requires an understanding of weather systems and the predictability of weather systems, climate change, pollution, the health benefits of exercise, the likelihood and severity of injury from a bicycle or car accident, and the relationship between speed, distance and time. Assuming that people make decisions based on their scientific knowledge, it stands to reason that having more available knowledge would improve a person’s ability to make informed decisions. Recalling facts can take a lot of cognitive effort (Kahneman, 2011). As a result, the human brain often employs less taxing methods when making judgements (Kahneman, 2011). Therefore, providing individuals with scientific insights about an issue does not always result in changes in their engagement with the issue (Longnecker, 2016).

It is commonly stated that the public would be better equipped to engage in debates about scientific policy if they are more scientifically literate, but there are different ideas regarding what this means. According to Bauer (2009), the traditional definition of science literacy includes having:

a) knowledge of basic textbook facts of science, b) an understanding of methods such as probability reasoning and experimental design, c) an appreciation of the positive outcomes of science and technology for science, and d) [rejected] superstitious beliefs such as astrology or numerology. (p. 223)

Priest (2013) argues that a more useful construct is what she terms critical science literacy. Critical science literacy involves the ability to determine “which facts, observations, and conclusions are most valid (and most reliable and relevant) to our individual and collective decisions (p. 144).” This can only be obtained by having some understanding of the sociology and philosophy of science (Priest, 2013). Priest’s definition of science literacy is less concerned with scientific facts and more focused on whether members of the public have the ability to identify the information that can help them make the best possible decision. For this reason, critical science literacy would be a better predictor of people’s ability to participate in science related debates.

A country could benefit from having a public that was involved in policy debate as this may help ensure that policy is directed by public values and that governments are held accountable for their decisions (House of Commons Public Administration Select Committee, 2013). Interestingly, a 2005 study of Americans, Canadians and Europeans found that only one third of the 28 200 participants surveyed agreed with the statement that decisions should be based on moral judgments compared to the two thirds that said it should be based on scientific facts (Gaskell et al., 2005). This could be interpreted as public values being perceived to have less importance in policy debates; however, it could also be argued that the results act to illuminate the value the survey participants place on science. If science is valued by the majority of people in these countries, then a science-based policy would still align with the majority of the public’s values. On the other hand, political worldviews can have polarizing effects on the way individuals interact with climate change information (Hart & Nisbet, 2012; Kahan et al., 2012) suggesting that people often underestimate the extent to which values influence information processing.

A related reason why science should be communicated to the public is that people are required to make decisions regarding new technologies (Stocklmayer & Bryant, 2012). Consider the controversy surrounding wind turbines. Deciding whether to allow a wind turbine in a community could require individuals to have an understanding of how this technology may impact a wide variety of scientific concepts including: electricity production, carbon emissions, bird populations, ecological systems, and human health. When asked who should be responsible for making decisions regarding technology Gaskell et al. (2005) found that three

quarters of the American, Canadian and European participants surveyed selected experts while only one quarter chose the public. Remembering that two thirds of participants in this study also stated that decisions should be based on scientific facts instead of moral judgments, one possible explanation could be that participants did not feel the public has enough scientific knowledge to make decisions about new technology. If this is true, then increasing the public's scientific literacy may result in people having more confidence in science related decisions made by the public.

Along with suggestions that increased knowledge of science will help individuals make decisions about technology, there is also the assumption that a more scientifically literate public will be more supportive of technological advancements which, in turn, will improve national prosperity (Ahteensuu, 2012; Royal Society, 1985; Stocklmayer & Bryant, 2012; Sturgis & Allum, 2004). However, Bauer (2009) challenged this claim, suggesting this relationship is only true in countries with low levels of economic development. In countries with high levels of economic development, the public tends to be more critical of science (Bauer, 2009). This contradicts the deficit model of science communication which assumes that negative attitudes towards science are primarily due to a lack of scientific understanding and, therefore, could be changed to be more positive by providing individuals with more information (Ahteensuu, 2012; Miller, 2001).

According to the deficit model, having experts inform the public about scientific issues will change public attitudes to be more supportive of science and technology (Ahteensuu, 2012; Bauer, 2009; Miller, 2001). As thinking critically is a skill valued by science educators (Bailin, 2002; Vieira & Tenreiro-Vieira, 2016), it is unsurprising that individuals who are well informed about science and science issues can be critical of science and technology (Bauer, 2009; Kahan et al., 2012). The ineffectiveness of the deficit model is one reason science communicators have shifted away from it (Miller, 2001). Unlike the top-down formulaic deficit model, newer models of science communication such as the Integrated Model of Science Communication (IMSC) champion a more holistic understanding of how individuals interact with scientific information (Longnecker, 2016). The IMSC considers the factors (both internal and external) behind *why* and *how* an individual might decide to engage, or not engage, with a particular piece of information (Longnecker, 2016), whereas the deficit model is solely concerned about what people know or do not know. The IMSC does not dismiss knowledge as being irrelevant to decision making, but proposes that knowledge is not the only determining factor. While the deficit model would suggest that simply informing the public that flying is harmful to the

environment is sufficient to reduce the number of flights, the IMSC suggests that different people will react to the message differently depending on factors such as: how the message was communicated, their identity, their personal values, attitudes, culture, supporting structures, control etc. (Longnecker, 2016).

While it is often argued that science should be communicated to the public so that individuals will be able to make more informed decisions (Stocklmayer & Bryant, 2012), this reasoning relies on the assumption that scientific knowledge plays a significant role in decision making. At this point, it is prudent to consider the role that attitudes and emotions may have in shaping decisions. Bohnet and Dickel (2011) defined attitudes as “an evaluation of an object of thought (pg. 392).” When making a decision the brain will often employ low effort approaches (Kahneman, 2011). For example, when it is too difficult for a person to determine what to think about a particular situation, they may instead subconsciously default to the easier question of determining how the situation makes them feel; they then use these feelings as a proxy for the original, more demanding cognitive question (Morewedge & Kahneman, 2010). This idea that decisions (specifically risk judgements) are made based on feelings is known as *affective heuristics* (Finucane, Alhakami, Slovic, & Johnson, 2000). Affective heuristics demonstrates that people do not always draw on their knowledge of a topic when making decisions. Under these circumstances being more informed may not make a difference.

Attitudes are also a major component of the Theory of Planned Behaviour (TPB) (Ajzen, 1985, 1991). The TPB, developed from the Theory of Reasoned Action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), postulates that behaviours are a result of behavioural intentions, which in turn, are formed by the combination of an individual’s attitudes towards the behaviour, their perceived control regarding their ability to act on that behaviour and their perceptions of subjective norms surrounding that behaviour (Ajzen, 1985, 1991). This suggests that changing people’s attitudes could cause a corresponding change in their behavioural decisions. While there has been some debate as to whether a moral component should be added to the TPB to increase the model’s predictability when explaining environmental behaviours (Botetzagias, Dima, & Malesios, 2015; Chen & Tung, 2014; Kaiser, 2006; Klöckner & Blöbaum, 2010), it seems counterintuitive that attitudes and *moral norms* would be independent factors. Moral norms are defined as an individual’s perceived moral responsibility to engage or refrain from participating in a behaviour (Ajzen, 1991). It stands to reason that believing a behaviour is right or wrong would influence a person’s negative or positive feelings towards that behaviour. Thus, moral norms may, in fact, be an antecedent to attitudes (Kaiser,

2006). Results have been mixed as to whether moral norms can act as a substitute for attitudes with Kaiser (2006) finding the two to be interchangeable and Botetzagias et al. (2015) finding moral norms to be related but separate. While more research is needed to untangle the relationship between attitudes and morals, the continuing value of the TPB to explain a variety of behaviours ranging from environment behaviours in the workplace (Greaves, Zibarras, & Stride, 2013), to buying halal (Shah Alam & Mohamed Sayuti, 2011), and posting selfies (Kim, Lee, Sung, & Choi, 2016) supports the idea that attitudes play an important role in making behavioural decisions.

1.3. Persuasion

1.3.1. *Is persuasion ethical?*

If we accept that changing attitudes may lead to changes in both risk judgements and behavioural decisions, the next question that needs to be addressed is whether it is ethical for science communicators to persuade the public. This is a topical question as the popular social networking site Facebook recently found itself embroiled in two separate scandals involving persuasive campaigns in the wake of the 2016 American Presidential election. The first scandal involved Russian operatives spreading divisive messages (Frenkel & Benner, 2018) while the second scandal involved the company Cambridge Analytica trying to improve their ability to send targeted persuasive messages by collecting personal data without individuals' knowledge or consent (Confessore & Hakim, 2017). For the purposes of this thesis, *persuasive communication* is defined as “any message that is intended to shape, reinforce or change the responses of another, or others” (Stiff & Mongeau, 2003, p. 4). This definition is useful for this thesis because a response could consist of an attitude, behaviour or expectation—all key components of this research.

A criticism of employing persuasive techniques when communicating science is that it takes away people's autonomy by dictating how they should react to an issue (Dahlstrom & Ho, 2012), and that it reduces public discourse, and therefore democracy, by homogenising reactions (Dahlstrom & Ho, 2012; Priest, 2006). On the other hand, champions of persuasion take a utilitarianism approach arguing that persuasion is ethical so long as it leads to the greater good (Dahlstrom & Ho, 2012; Freeman, 2009). This position is problematic as defining the greater good is subjective and will vary depending on the person, society and time period (Freeman, 2009). Baker and Martinson (2001) created the TARES test, to act as a guideline for persuasive communication. It states that the five points to ethical persuasion are: Truthfulness

of the message, **A**uthenticity of the persuader, **R**espect for the persuadee, **E**quity of the appeal and **S**ocial responsibility for the common good (Baker & Martinson, 2001). Adapting the model for advocacy persuasion, Freeman (2009) argued that when promoting a moral issue greater consideration should be given to respecting the ‘victims’ (the disadvantaged parties) values than the dominant values. Using this adaptation of TARES, even if the majority of citizens in a country stated that they did not want their government engaged in climate change mitigation, it would still be ethical to engage in persuasive communication so long as those who would be most disadvantaged by climate change said they wanted the government to mitigate climate change. This thesis recognises the concerns regarding the use of persuasive techniques to change individuals’ perceptions; however, it maintains that with regards to climate change, there is also a moral obligation to those who will suffer from the consequences of climate change to encourage behaviour change.

1.3.2. The Elaboration Likelihood Model of persuasion

The Elaboration Likelihood Model (ELM) (Petty & Cacioppo, 1986) is one of the most influential theories to describe how persuasive communication is processed (Kitchen, Kerr, Schultz, McColl, & Pals, 2014). It proposes that messages are processed in one of two ways: either passing through the central route or the peripheral route (Petty & Cacioppo, 1979, 1986). If an individual has both the motivation and ability to process the message, then the message will pass through the central route resulting in the individual thinking extensively about the message (Petty & Cacioppo, 1986). Otherwise, the message will go through the peripheral route which relies on heuristics meaning that less effort is committed to thinking about the message (Petty & Cacioppo, 1986). This highlights the idea that individuals can be persuaded by other factors beyond logical arguments and facts. For example, *affect* (i.e. positive or negative emotions) can influence both the central and peripheral pathways (Kitchen et al., 2014). Science communicators should be careful not to dismiss these affective elements as relying solely on information to persuade individuals could limit the reach and effectiveness of their messages.

One criticism of the ELM is that messages can only be attributed to the central or peripheral processing in retrospect (Kitchen et al., 2014; Stiff & Mongeau, 2003). Thus, it is more of an explanatory tool than a predictive tool (Stiff & Mongeau, 2003). This is inconvenient for stakeholders wanting to use the ELM to design persuasion campaigns. A second problem with the ELM is that researchers have found it difficult to replicate (Kitchen et al., 2014; Stiff & Mongeau, 2003). From a research perspective, this second critique is more

concerning as models should be both replicable and generalisable for them to be useful. The lack of replicability also calls into question either researchers' understanding of the ELM or the ELM's validity. Despite this, the ELM is still a useful model to be aware of when trying to determine why a message may or may not have been persuasive.

1.4. Story as a tool for communicating science

Considering the number of *narratives* people are exposed to through blogs, novels, television, and films it makes sense for researchers to investigate the impacts that science narratives can have (Dahlstrom, 2014). Moreover, there is evidence that the human brain is conditioned for stories (Gottschall, 2012; Haven, 2007). This has led to the exploration of narratives as a tool to communicate science both to students (Avraamidou & Osborne, 2009; Ishigami, 2013; Klassen, 2010; Negrete & Lartigue, 2010; Norris, Guilbert, Smith, Hakimelahi, & Phillips, 2005) and the public (Dahlstrom, 2014). Memory and recall, emotions, observational modelling, moral values, probability judgments, and persuasion are six factors that may be influenced by story. Before exploring these aspects in more detail, it is necessary to clarify what constitutes a story.

According to Haven (2007), a *good story* is defined as “a detailed character-based narration of a character’s struggles to overcome obstacles and reach an important goal” (p. 79). This is different to a narrative as a narrative occurs when someone/thing (i.e. character) encounters a series of events over a certain timeframe as told by a narrator (Avraamidou & Osborne, 2009; Dahlstrom, 2014). Comparing the two definitions reveals that all good stories are narratives but not all narratives necessarily make good stories (Haven, 2007). The process of overcoming a hurdle may make story a more engaging and effective format than narrative. For the purposes of this literature review, the research on narratives will be used to support the arguments for the usefulness of story since good stories are a type of narrative as it is beyond the scope of this thesis to hunt down the original texts used in all the narrative literature to determine if they should be reclassified as stories.

1.4.1. Memory and recall

The first reason that story may be a useful tool for science communication is that it has been linked to increased retention of information. In order to test the effectiveness of story and narratives on memory and recall, researchers have used lists of facts (e.g. Ishigami, 2013; Negrete & Lartigue, 2010) or *expository texts* as comparisons (e.g. Nigro & Trivelato, 2012; Zabucky & Moore, 1999). According to the Merriam-Webster (2018) dictionary, the purpose

of exposition is “to convey information or explain what is difficult to understand.” The explanatory nature of exposition is why the style is predominant in textbooks. Expository texts are a useful comparison because they enable researchers to test the influence of a text’s style since the same factual information can be incorporated into both narratives and expository texts.

A study by Negrete and Lartigue (2010) investigating recall found that although British undergraduate students were initially able to recall more chemistry facts if the information was presented as a list of facts instead of a short story, when retested a week later the recall of those who had read the list of facts significantly decreased while the recall of those who read the story did not. Ishigami (2013) repeated this study in Australia extending the study to a total of eight weeks. Like Negrete and Lartigue (2010), Ishigami found that students who read the list of facts initially scored higher than students who read the story (although the difference was not significant), but that eight weeks later the students who read the story intervention scored significantly higher than the students who read the list of facts. Similarly, one week after reading about sickle-cell anaemia, fourteen and fifteen-year-old Brazilian students who read a popular science magazine article tended to score higher when tested on their knowledge and applied knowledge of sickle-cell anaemia compared to the students who read the same information in a textbook (Nigro & Trivelato, 2012). Taken together, these results suggest that students may remember scientific information longer if it is presented in story, and that this trend may be applicable across cultures. Since individuals cannot use information to make decisions if they are unable to retrieve this information from their memory, increasing an individual’s ability to retain and recall information may be beneficial to science communicators as it could increase the chance of this information being utilised.

It has been suggested that the familiar framework of story makes it easier to organise and retrieve facts (Willingham, 2004). Both younger adults (aged 18-34) and older adults (aged 61-77) have been shown to recall more information when it is presented in narrative text compared to expository text even though it took both groups less time to read the narrative text than it did to read the expository text (Zabrucky & Moore, 1999). This suggests that information presented using a narrative structure may be easier to process (Zabrucky & Moore, 1999). Stories are structured around a cause and effect pattern and it may be this format of expected causality that makes information in stories easier to process (Willingham, 2004). For example, students were able to recall more information from narratives where causality was clearly stated than in narratives where information appeared randomly (Dahlstrom, 2010,

2012). This relationship remained true even after two weeks had passed (Dahlstrom, 2012). Given that the human brain typically defaults to low-effort systems, if narratives provide an easier method of encoding or recalling information then they might increase the likelihood of that information being used in decisions and decrease the likelihood of utilising other low effort cues such as affective heuristics.

1.4.2. Emotions

The second reason that stories may be a useful tool for science communication is because of their influence over emotions. Section 1.2. discussed how emotions can serve as low effort cues for making judgments (Kahneman, 2011). The fact that stories can elicit emotions and that these emotions can endure long after a story is finished (Mar, Oatley, Djikic, & Mullin, 2011) suggests that stories may be able to influence real world decisions at an emotional level. This is important for decision making as priming an audience to have emotional responses can influence how they interpret information. A nationally representative study conducted following the 9/11 terrorist attacks found that emotionally priming Americans to be either angry or afraid resulted in differing evaluations of how they perceived the threat of terrorism (Lerner, Gonzalez, Small, & Fischhoff, 2003). People who were primed with fear were more likely to report higher risk estimates while people who were primed with anger reported lower risk perceptions (Lerner et al., 2003). Likewise, priming French undergraduate students with positive emotions changed how they reacted to loss framing by decreasing their risk seeking gambling behaviours (Cassotti et al., 2012). Therefore, by emotionally priming the public, science communicators may be able to influence public perceptions and willingness to accept risky scientific endeavours or new technologies (Anderson, Brossard, Scheufele, Xenos, & Ladwig, 2014).

Since stories can also produce enduring emotions it is not unrealistic to assume that they could act to emotionally prime audiences (Mar et al., 2011). This has implications for science communication as even reading a completely unrelated but emotional story could change the way in which an individual judges the risks surrounding a particular scientific issue. To some extent, this interaction will always be beyond communicators' control as it would be unreasonable (and often unethical) to dictate when and what stories the public are exposed too. Nonetheless, it would be useful for science communicators to explore the extent to which stories could act to emotionally prime audiences and how this may affect their scientific risk perceptions as this could be useful information for directing and understanding reactions to the media landscape.

Inspiring empathy may be another way that story can affect an individual's emotions. The Theory of Narrative Empathy states that stories make people more empathetic (Keen, 2006). The idea is that when reading a story, the reader undergoes similar feelings and experiences as the characters within the story (Keen, 2006). It is hypothesised that this process is facilitated by mirror neurons (Keen, 2006). Mirror neurons are neurons that fire when an animal or individual witnesses an action even though they are not physically participating in that action themselves (Iacoboni, 2009). As such, part of their brain still experiences the action (Iacoboni, 2009). This is important for science communicators because emotions may also be subject to mirroring (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003).

Carr et al. (2003) found that observing facial expressions activates many of the same areas of the brain as imitating facial expressions and that this mental experiencing of the action helps humans understand and be empathic with the individual displaying the observed emotion. This was further supported by a German study that found reading short, fear-inducing excerpts from the fictional novel *Harry Potter* stimulated the part of the brain thought to be associated with the affective empathy (more specifically pain empathy) while neutral excerpts did not (Hsu, Conrad, & Jacobs, 2014). This suggests the reader's brain likely experiences the same feelings as the characters. It is through this vicarious experience that the reader becomes more understanding of different people's situations (Keen, 2006). In terms of science communication, narrative empathy could lead to readers being more empathetic to how scientific issues or policies could affect people (or animals) beyond themselves. This in turn, may affect the reader's negative or positive feelings towards that scientific issue, and ultimately their decisions.

Further support for the Theory of Narrative Empathy comes from a Canadian study which found that university students who habitually read fiction were more empathetic than people who primarily read non-fiction (Mar, Oatley, Hirsh, dela Paz, & Peterson, 2006). The authors note that the relationship between empathy and fiction could also be due to the fact that empathetic people may enjoy reading fiction more than those who are less empathetic and thus read more fiction as a result. Interestingly, people who reported being more transported into the stories scored higher empathy scores, and fiction was more likely to cause transportation than non-fiction (Mar et al., 2006). This suggests that fictional stories may be better at creating empathy. Three areas that would be interesting for researchers to explore regarding narrative empathy would be: i) how the vicarious experiences readers encounter in story could be used to create emotional connections between the reader and a scientific topic, ii) how these subsequent emotional connections may contribute to behavioural decisions, and iii) whether

fictional stories create more empathy regarding scientific issues (for example climate change) than non-fictional stories.

1.4.3. Observational modelling

Observational and behavioural modelling is the third reason that story might be a useful tool for communicating science. As Harré (2011) points out “Good stories, stories that will help propel us towards a sustainable world, compel imitation” (p. 53). Humans often model their own behaviours after watching how others behave (Bandura, 1965). Thus, individuals can learn vicariously through the actions of others (Bandura, 1965). It is possible that this emulation could extend into stories (Green, 2006; Harré, 2011; Moyer-Gusé, 2008). For example, a Canadian study of 194 avid readers asked participants to describe why they liked their favourite book (Ross, 1999). One quarter of participants said they enjoyed it because it provided them with a model for living (Ross, 1999). This suggests that not only can stories offer an exemplar of how to behave, but that they can be likeable because of it.

Stories provide role models (either positive or negative) in the form of characters (Rogers et al., 1999). Role models can motivate (e.g. Campbell & Wolbrecht, 2006; Marx, Ko, & Friedman, 2009) and inspire people (Lockwood, 2006; Lockwood & Kunda, 1997) possibly by outlining strategies that either lead to success or failure (Lockwood, Jordan, & Kunda, 2002; Rogers et al., 1999). There is some evidence to suggest that people have to believe their role models’ success is attainable (Lockwood & Kunda, 1997). Therefore, non-fiction stories may be more inspirational than fictional stories because they are known to be achievable. For science communicators wanting to influence behaviour, writing stories with characters who model the targeted behaviour may give readers role models to emulate. It may also impart strategies and concrete examples that readers could follow. Providing explicit examples of how to act may be an important aspect of inspiring behaviour change; a Chinese study found that providing instructions on how individuals can mitigate climate change increased participants’ efficacy and motivation to seek out more information (Xue et al., 2016). This in itself is unlikely to affect large scale change. Still, depicting ideal behaviours in stories might be able to increase individual’s efficacy if it provides individuals with guidelines of how to behave.

Similar to the notion that observational modelling through story could influence real world behaviours is the idea that the *social norms* depicted in stories could also influence behaviours. Social norms are “rules and standards that are understood by members of a group and that guide and/or constrain social behaviour without the force of laws” (Cialdini & Trost, 1998, p. 152). From a science communication perspective, social norms are important as they

can influence environmental behaviours such as littering (Cialdini, Reno, & Kallgren, 1990), recycling (Schultz, 1999), household energy consumption (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007) and hotel towel washing (Goldstein, Cialdini, & Griskevicius, 2008). This is relevant to science communication as it suggests that creating stories in which the desired environmental behaviour is normal could increase the likelihood of the reader engaging in that targeted behaviour. Therefore, social norms created in stories and narratives may theoretically influence people's behaviours.

1.4.4. Moral values

Another reason story may be a useful instrument for science communication is because it can reinforce moral values. Section 1.2. alluded to the role of moral values in guiding decisions about scientific policy. For thousands of years, stories (such as fables) have been used as a medium for teaching and reinforcing moral values (Gottschall, 2012). Therefore, stories may provide a familiar framework for people to understand science issues as moral issues. This may be important as behavioural engagement has been linked to moral norms (e.g. Ajzen, 1991; Botetzagias et al., 2015; Chen & Tung, 2014; Han & Hyun, 2018; Shin & Hancer, 2016). Moral norms have been identified as significant predictors of a wide range of behaviours including intentions to conserve water and reuse towels in hotels (Han & Hyun, 2018), buying foods locally (Shin & Hancer, 2016), and recycling (Botetzagias et al., 2015). Therefore, if science communicators convince individuals that they have a moral responsibility to engage in a particular behaviour, it may increase the likelihood of these individuals performing that behaviour.

1.4.5. Probability judgements

A fifth reason that story might be a useful tool for science communication pertains to judging probabilities and risk. Many people struggle to think statistically which makes it difficult to calculate probability and judge risk (Kahneman, 2011; van der Linden et al., 2015). Instead of spending a lot of effort to mathematically determine the likelihood of an event occurring, an individual may make likelihood judgements based on how quickly an example comes to mind (Tversky & Kahneman, 1973). This phenomenon is known as the availability heuristic (Tversky & Kahneman, 1973). It is possible that if individuals encounter stories depicting the consequences of a scientific issue this could affect how quickly they recall the situation and possibly influence their perceptions regarding how likely they perceive that event to be. There have been a few studies investigating the effects that stories in the form of

Hollywood movies can have on viewers' risk perceptions (Leiserowitz, 2004; Lowe et al., 2006; Sjöberg & Engelberg, 2010).

Leiserowitz (2004) found Americans who had watched the 2004 disaster film *The Day After Tomorrow* were more likely to be concerned about climate change immediately following the movie than those who had not watched the movie. About half of the respondents who had seen the film said that the movie had increased their concern towards climate change. Similarly, Lowe et al. (2006) found moviegoers in Norwich, England to be slightly more concerned about climate change immediately after watching the same film. These results suggest that stories may influence public perceptions of risk with respect to a scientific issue. However, later focus groups revealed that while participants found the movie thought-provoking, respondents were sceptical regarding the likelihood of a sudden, drastic shift in temperatures occurring in real life, especially since it contradicted the current scientific understanding of climate change (Lowe et al., 2006).

There are two possible explanations for Lowe et al.'s focus group results with very different implications for science communication. The first is that the increased concern is short lived and that by the time Lowe et al. (2006) conducted the follow-up interviews the effect had already worn off and participants had become less concerned about climate change. Howell (2011) found that levels of climate change concern had not dropped 10 weeks after watching the climate change film *The Age of Stupid* but that they did show a slight decrease after 14 weeks. This supports the idea that story (at least in the form of movies) may only exert a short-term influence on people's perceptions of climate change risk. To maintain these increased levels of concern about climate change it is possible that individuals would need repeated reinforcement through similar stories. An America study highlighted the importance of repeated, complementary messaging in stories (Hether, Huang, Beck, Murphy, & Valente, 2008). The study found that women were more likely to schedule breast cancer screenings if they had watched the breast cancer storylines depicted in *both* the television shows *ER* and *Grey's Anatomy* (Hether et al., 2008). These episodes aired three weeks apart from each other which could have helped to prolong participants' concern or perhaps reminded participants about the importance of the issue.

The second explanation for Lowe et al.'s results could be that participants' newly increased levels of concern led them to actively search for information about climate change. At this point they learned that the information depicted in the film did not align with the scientific understanding of climate change and this subsequently reduced the impact of the movie. In this case, stories may need to be at least somewhat realistic to cause long term change

in people's risk perceptions. Sjöberg and Engelberg (2010) followed up on this idea by investigating whether or not the more realistic movies *China Syndrome* and *Towering Inferno* could change viewers' perceptions regarding the risk of nuclear power and fire respectively (Sjöberg & Engelberg, 2010). In both cases, there was no significant change in people's risk perceptions (Sjöberg & Engelberg, 2010). As it stands, more research is needed to investigate the extent to which story may activate an individual's availability heuristic. Based on the results from the above stories it would be useful to further investigate how long changes in risk perception last following exposure to the story, the importance of scientific accuracy and perceived realism in changing risk perceptions and whether different topics (climate change vs nuclear power) are more likely to affect an individual's availability heuristic.

1.4.6. Narrative persuasion

Narrative persuasion is a sixth reason that story might be a useful tool to help communicate science. Research into narrative persuasion has shown that narratives can influence people's beliefs (e.g. Appel & Malečkar, 2012; Appel & Richter, 2007; Dahlstrom, 2012; Green & Brock, 2000; Nan, Dahlstrom, Richards, & Rangarajan, 2015), behavioural intentions (e.g. Appel & Mara, 2013; Kim, Bigman, Leader, Lerman, & Cappella, 2012; Moyer-Gusé & Nabi, 2010), and behaviours (Rogers et al., 1999). A meta-analysis investigating 74 papers of quantitative controlled experiments on narrative persuasion found that stories can influence beliefs, attitudes, intentions and behaviours (Braddock & Dillard, 2016). Thus, narrative persuasion may be an effective method of targeting multiple stages of the decision-making process. For science communicators specifically interested in changing behaviours, Baranowski, Buday, Thompson, and Baranowski (2008) identified story as one mechanism that video games can employ to change children's health behaviours. However, in their meta-analysis of the effectiveness of narratives compared to non-narratives in changing health behaviours, Shen, Sheer, and Li (2015) noted that narratives are more effective at changing preventative behaviours than stopping people from continuing to engage in harmful behaviours. Thus, story may be a tool more suited for targeting some behaviours than others.

Interestingly, narrative persuasion does not seem to be affected by the fact that stories can be fictional. There is evidence to suggest that individuals judge information they have read in fictional stories as being true. For example, Marsh, Meade, and Roediger III (2003) found that undergraduate students tended to use the information they had read in the stories to answer test questions. Students who read stories containing the correct information were more likely to answer the corresponding test questions correctly while students exposed to misinformation

were more likely to answer the corresponding test questions incorrectly (Marsh et al., 2003). Although students reported nonfiction stories to be more trustworthy than fictional stories, labelling a story as fictional did not decrease its persuasiveness (Appel & Malečkar, 2012). Similarly, meta-analysis by Braddock and Dillard (2016) found no difference in the persuasiveness of fiction and non-fiction stories. This may be because individuals who respond in a story consistent manner (regardless of whether their answers were factually correct) were aware that they had just read the information in the story, but attribute that same information as being previously held knowledge (Marsh et al., 2003). Confusing information sources is not limited to story as Los Angeles residents attributed their knowledge of homeostasis to school, despite the fact that awareness of the topic significantly increasing in the community following the opening of a Science Center with a permanent display on homeostasis (Falk & Dierking, 2013).

The fact that information obtained through fictional stories is judged to be as true as information obtained through non-fictional stories means that science communicators do not need to be constrained to nonfiction stories to get their messages across. This gives communicators more liberty to design characters and situations that could maximize persuasion. Unfortunately, the uptake of information from story may be a double-edged sword as it means misinformation can also be disseminated through story. In the past, misinformation has purposefully been used to prolong controversy and discredit science communication efforts including smoking and climate change (McCright & Dunlap, 2017; Oreskes & Conway, 2010). Because of this, science communicators need to be very careful of the information used within story to make sure that misinformation is not being spread.

1.4.6.1. Subtlety

One factor that might influence a story's persuasiveness is message subtlety. Moyer-Gusé and Nabi (2010) found that university students were more likely to resist narrative persuasion when they recognised a narrative's persuasive intent. This is unsurprising as other studies have found that telling participants that a message is intended to be persuasive will reduce its effectiveness (e.g. Fransen & Fennis, 2014; Petty & Cacioppo, 1979). Results from the Moyer-Gusé & Nabi, (2010) study showed that the story narrative (an episode of a popular teen drama) was less likely to be identified as having a persuasive intent than the news style narrative, and as a result, students who watched the story intervention were more likely to change their behavioural intentions regarding safe sex (Moyer-Gusé & Nabi, 2010). This

suggests that if science communicators make the persuasive intent of the stories too obvious, it is likely to reduce the persuasiveness of the message.

One way to increase message subtlety could be to have the persuasive message be peripheral to the plot of a story. A short story about a kidnapping which included a statement about teeth brushing caused German students to report that brushing their teeth was harmful even though this misinformation did not play a crucial role in the kidnapping plot (Appel & Richter, 2007). Interestingly, the students' belief in this misinformation was even stronger when they were resurveyed two weeks later (Appel & Richter, 2007). This suggests that even tangential information may be absorbed and remembered by the reader. Therefore, by not placing the persuasive message front and centre in the story, science communicators may be able to increase its potential persuasiveness.

1.4.6.2. Identification with story characters

Identification with characters may also influence the effectiveness of narrative persuasion. According to the ELM and the Entertainment Overcoming Resistance Model, people are less likely to scrutinise, resist or counterargue with messages presented in narratives because they identify with the characters (Moyer-Gusé & Nabi, 2010). The more transported (immersed) participants are into a narrative, the more likely they are to agree with the viewpoints of the characters (Green & Brock, 2000). It is possible that individuals may even adopt the characteristics or values of characters they identify with. For example, when university students identified with characters in movie clips they were more likely to increase the number of self-reported characteristics that were character consistent following the viewing (Sestir & Green, 2010). In a series of studies on prejudice, Vezzali, Stathi, Giovannini, Capozza, and Trifiletti (2015) found that after reading a passage on discrimination from the fictional novel *Harry Potter and the Chamber of Secrets* the attitudes of Italian elementary school students who identified with the main character Harry Potter (the best friend of the girl being discriminated against) became more positive towards refugees. The authors also found that identification with Harry Potter in Italian high school students was linked to more positive attitudes towards the LGBT community (Vezzali et al., 2015). This indicates that social justice values may be transferable through identification with a character.

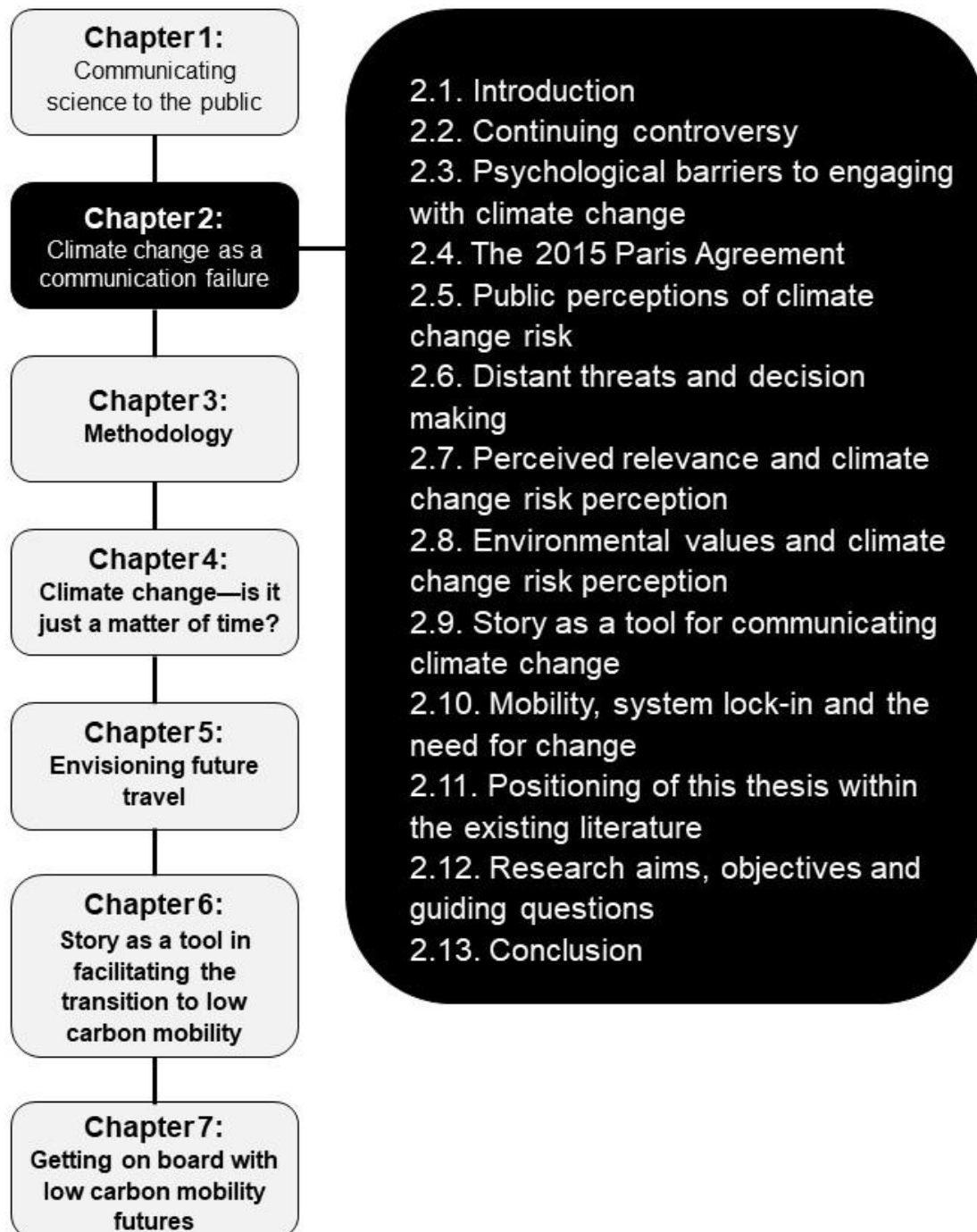
It is not entirely surprising that audiences assume the characteristics or values of characters they identify with considering the Theory of Narrative Empathy (Section 1.4.2.). Since it appears that readers/viewers can vicariously experience the character's feelings it is logical that these feelings may translate into the audience experiencing, at least temporarily,

the character's values. If these character values are consistent with the persuasive message the author is trying to impart then it would make sense that increased identification leads to increased attitude or behaviour change. Alternatively, individuals may view characters that they identify with as a potential role model and adopt their values to emulate a desired way of life (Section 1.4.3.). Whatever the case may be, creating main characters who are similar to audience members and espouse the values that the science communicator wished to impart could increase the persuasiveness of science communication narratives. Since stories can have multiple characters, having characters with a wide variety of worldviews may increase the chance that the reader will identify with one of the characters in the story and ultimately the likelihood of message uptake.

1.5. Conclusion

It is often argued that science should be communicated to the public to foster empowerment through informed decisions; however, this justification ignores all the other factors such as cognitive effort, emotions, moral values and worldviews that influence an individual's decision-making process. Story may be able to influence decisions by affecting recall and memory, emotional responses, morals, behavioural modelling, probability judgements and narrative persuasion. This first chapter has presented an argument for why science communicators should consider using story. Chapter Two will expand on this idea by exploring how story might be able to address some of the challenges pertaining to communicating about climate change.

Chapter 2: Climate change as a communication failure



2.1. Introduction

Climate change is arguably the most important scientific issue currently facing humanity. Applying the argument from the Chapter One that story should be considered as a tool for communicating science, this chapter explores why story may be an appropriate tool for communicating about climate change. The chapter begins by explaining the challenges of communicating about climate change. It proceeds to discuss how thinking about climate change as a future threat could affect risk perception and how story might address these challenges. Next, the chapter describes why low carbon mobility is an important context to explore climate change. After reviewing these literatures, notable gaps are identified and how this thesis addresses those gaps is explained. The research aim and guiding research questions are also stated.

2.2. Continuing controversy

Kahan (2015) referred to the inability of accessible and convincing scientific facts to dispel the controversy surrounding climate change as “the most spectacular science-communication failure of our day” (pg 2). In 1988 the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) created the Intergovernmental Panel on Climate Change (IPCC) to report upon the state of climate change research, and to provide realistic response recommendations (<http://www.ipcc.ch/>). Thirty years and five IPCC reports later, climate change continues to be a monumental problem with the quantity of *greenhouse gases* (GHG) in the atmosphere reaching unprecedented levels and threatening irreversible changes to the global climate (IPCC, 2014). Despite the overwhelming acceptance within the scientific community that climate change is *anthropogenic* in nature (Oreskes, 2004), this statement remains controversial in some public spheres (Capstick & Pidgeon, 2014; McCright & Dunlap, 2011a; Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011). For example, American President Donald Trump has voiced scepticism regarding climate change multiple times both before and during his presidency (Figure 2.1). This is problematic as, if left unchecked, climate change is likely to result in serious consequences including extreme weather, ecosystem destruction, species extinction, crop loss, human illness, and population displacement (IPCC, 2014). The fact that scepticism towards anthropomorphic climate change persists despite decades of communication efforts to convey the importance of limiting carbon emissions suggests that different methods, such as story, should be trialled to communicate climate change.



Figure 2.1: Examples of American president Donald Trump's sceptic tweets regarding climate change before and after his election in 2016.

2.3. Psychological barriers to engaging with climate change

A growing number of researchers have turned to psychology to help explain why people struggle to engage with climate change (e.g. Gifford, 2011; Kahan et al., 2012; Stern, 2011; van der Linden et al., 2015). Gifford (2011) suggested that some people struggle to understand climate change because it is difficult for the human brain to comprehend this complex issue. Climate change occurs because GHGs, particularly carbon dioxide, trap longwave radiation in the atmosphere (Mitchell, 1989). The more carbon accumulates the greater this greenhouse effect will be. Unfortunately, people have trouble comprehending carbon accumulation in the atmosphere in the presence of climate change mitigation efforts (Stermann & Sweeney, 2007). A study of educated students at an elite American university found that 58% of participants suggested that stabilising carbon emissions would stabilise the amount of carbon in the atmosphere; however, this is incorrect as atmospheric carbon would continue to accumulate (Stermann & Sweeney, 2007).

The fact that people have difficulty understanding the principles of accumulation could make it challenging for them to make effective decisions about their carbon use. As a result, they may have a relatively low carbon capability. Carbon capability is defined as:

the ability to make informed judgements and to take effective decisions regarding the use and management of carbon, through both individual behaviour change and collective action. (Whitmarsh, O'Neill, Seyfang, & Lorenzoni, 2009, p. 2)

Since it takes cognitive effort to calculate inflow and outflow dynamics, climate change communication should explore ways to reduce the cognitive effort required. For example, Guy, Kashima, Walker, and O'Neill (2013) found that non-expert Australians who received climate change information in the form of a bathtub analogy were more likely to correctly answer a

question about carbon emission reduction and atmospheric carbon stabilisation than those who saw the same information in a graph. This analogy compared carbon entering the atmosphere to water filling a bathtub that has a small drain and no plug (Guy et al., 2013). Essentially, water gushed out of the tap and mostly filled the tub. Turning down the tap slowed down how fast the tub filled, but the water levels kept rising until the tap was turned off (Guy et al., 2013). The analogy illustrated the point that stabilising the amount of water/carbon entering the bathtub/atmosphere does not stop the total bathwater/atmospheric carbon from increasing. The familiarity of metaphors or of filling and draining a bathtub helped reduce the cognitive load required to understand climate change accumulation. Therefore, finding ways to embed climate change information within familiar situations is likely to communicate climate change science more effectively.

A further complication regarding engaging with climate change is that an individuals' comprehension of climate change can be influenced or overshadowed by their values and worldviews (Gifford, 2011; Kahan, 2015; Kahan et al., 2012). For example, a study found little difference between the responses of Liberal Democrats and Conservative Republicans when asked about their knowledge of climate change, or more specifically what *climate scientists believe* about climate change (Kahan, 2015). However, when asked about their own perceptions of climate change, worldviews had a significant influence (Kahan et al., 2012; McCright & Dunlap, 2011a). This suggests there is a difference between what people *know* about climate change and what they *believe* about climate change (Kahan, 2015). Unfortunately, this means that science communicators should figure out how to create messages that align with peoples' worldviews and values (Kahan, 2015). This is difficult when these values inherently conflict with climate change mitigation (Gifford, 2011).

To help science communicators target their climate change messages more effectively an audience segmentation analysis was conducted in the United States in 2008 (Maibach, Roser-Renouf, & Leiserowitz, 2009). Based on participants' attitudes, beliefs, behaviours and policy preferences regarding global warming, the report identified six distinct groups: alarmed, concerned, cautious, disengaged, doubtful and dismissive (Maibach et al., 2009). As an example of how values can differ between the six groups, those in the *alarmed* segment were more likely to be: Democrats, value government intervention, hold strong egalitarian values and prioritise environmental protection over economic growth; the *disengaged* were more likely to hold traditional religious beliefs and prioritise economic growth over the environment although they are still likely to be Democrats with egalitarian values (Maibach et al., 2009).

Another factor that has been identified as a barrier to engaging with climate change mitigation is the perceived distant nature of climate change (Leiserowitz, 2005; Lorenzoni et al., 2007; Spence, Poortinga, & Pidgeon, 2012; van der Linden et al., 2015). This includes both temporal and spatial distance—i.e. the perception that climate change will only affect the distant future or areas far away (Carmi & Bartal, 2014; Lorenzoni et al., 2007; Spence et al., 2012; van der Linden et al., 2015). The IPCC often discusses climate change in reference to the years 2050 or 2100 (IPCC, 2014). These are both distant timeframes that may reinforce the impression that climate change is a temporally distant threat. There is evidence supporting the idea that people associate climate change with the future. A study by Wang et al. (2018) found that Australian university students tended to refer to climate change as a future problem. A study conducted in the U.K. in 2010 found that although about 41% of participants stated that they were already feeling the effects of climate change, another 40% said they thought the U.K. would not feel the effects of climate change for another 10 - 50 years, and approximately 15% said it would take more than 50 years (Spence et al., 2012). Interestingly, Gallup polls from 2006 and 2007 found that although almost 60% percent of Americans believed climate change was already occurring 62% said that it would not affect them within their lifetime (Nisbet & Myers, 2007) suggesting that people may differentiate between climate change affecting their country and themselves personally.

This perceived distance may influence how people think about climate change, which in turn could affect their assessment of climate change risk. Perhaps due to the perceived distant nature of climate change, stakeholders in the New Zealand ski-industry perceived current weather variability to be a separate and greater risk than climate change, despite the fact that both risks could negatively harm the industry (Hopkins, 2015). In their U.K. study, Spence et al. (2012) found temporal distance to have a weak negative correlation to levels of climate change concern. Additionally, Leiserowitz (2006) attributes the temporally distant nature of climate change as one of the reasons many Americans only report a moderate level of concern with respect to climate change. Based on these results, it would seem that perceiving climate change to be a distant threat lowers the chances that an individual will be concerned about climate change.

2.4. The 2015 Paris Agreement

Since climate change is a global problem, it stands to reason that there should be a global strategy for reducing carbon emissions. There have been three notable attempts at

creating an international action plan to address climate change: the 1997 Kyoto Accord, the 2009 Copenhagen Accord, and the 2015 Paris Agreement. Unlike the Kyoto Accord which only targeted developed nations or the Copenhagen Accord which was neither long-term nor legally binding, the 2015 Paris Agreement was signed by 188 countries, requires countries to re-assess their emission reducing pledges every five years, and is a legal treaty (Bodansky, 2016; Savaresi, 2016). For this reason, the 2015 Paris Agreement was heralded as a political triumph for climate change mitigation (Dimitrov, 2016). That being said, ratifying the Paris Agreement is only the first step towards reducing global carbon emissions, with the more difficult task of meeting mitigation targets still to come.

One of the major outcomes of the Paris Agreement was the pledge to prevent global temperatures from rising more than 1.5°C above pre-industrial levels (United Nations, 2015b); however, based on the Intended Nationally Determined Contributions (i.e. the proposed emission reductions) that had been submitted by 160 countries as of the end of 2015, meeting this target will be challenging (Rogelj et al., 2016). To complicate matters further, the United States of America officially withdrew from the Paris Agreement on June 1st, 2017 (Shear, 2017). As the second largest emitter of GHGs (EPA, 2017; Zhang, Chao, Zheng, & Huang, 2017), successful mitigation of climate change will require American participation. America's withdrawal has also led to significant financial consequences in the form of funding cuts for climate change mitigation which could impact the ability of other countries to implement climate change mitigation strategies (Zhang et al., 2017).

In addition, the Paris Agreement failed to address mitigating the maritime shipping and aviation industries (Scott, Hall, & Gössling, 2016; Scott, Smith, Rehmatulla, & Milligan, 2017). This is problematic as the GHGs from both sectors are predicted to continue to increase at alarming rates, putting the industries at odds with the notion of the low carbon future espoused by the Paris Agreement (Becken & Mackey, 2017; Scott et al., 2016; Scott et al., 2017). Without the international contract and pressure of the Paris Agreement, these industries may be less motivated to reduce and restrict emissions within their sectors. By not holding the maritime and aviation industries accountable for their GHGs emissions in the Paris Agreement, the international community may struggle to meet mitigation targets. Overall, the 2015 Paris Agreement is a promising step in guiding climate change mitigation but its effectiveness is not assured. Science communicators should continue to explore complementary methods of engaging individuals in climate change mitigation.

2.5. Public perceptions of climate change risk

There are many factors that may contribute to how an individual assesses the risk that climate change poses. Risk has often been defined as a combination of 1) the probability that a hazard (danger) will occur and 2) the subsequent consequences that will unfold if said hazard does occur (Kaplan & Garrick, 1981). However, risk analysis is actually more complicated since the evaluation of risk is influenced by a myriad of other factors including identity, social norms, affect, gender, experience and level of expertise (Miller & Sinclair, 2012; Morioka, 2014; Slovic, 1999; Wynne, 1992). As discussed in Section 1.2., humans do not always employ well-reasoned, logical thought when making decisions as this requires too much effort (Kahneman, 2011). With respect to climate change, studies have shown that climate change risk perceptions are influenced by affect (Leiserowitz, 2006) and gender (McCright, 2010; Sundblad, Biel, & Gärling, 2007). Worldviews have also been shown to influence both people's perceptions of climate change risk (Kahan et al., 2012), as well as how they perceive the credibility of climate change experts (Kahan, Jenkins-Smith, & Braman, 2011). Thus, communicators wanting to influence climate change risk perceptions need to be aware that there are many competing elements to consider.

It is important to understand not just how politicians and high-level decision makers judge climate change risk, but also how the public assesses climate change risk. Studies have reported correlations between perceived climate change risk and willingness to engage in more environmentally sustainable behaviours (O'Connor, Bord, & Fisher, 1999; Semenza et al., 2008; Spence, Poortinga, Butler, & Pidgeon, 2011; Spence et al., 2012). One study found that Americans were more likely to say they would voluntarily engage in behaviours that are more environmentally sustainable if they also agreed that climate change will have negative consequences (O'Connor et al., 1999). Another study noted that Americans were more likely to report having changed their behaviours if they also described having higher levels of concern about climate change (Semenza et al., 2008). Two separate studies from the U.K. found that levels of climate change concern correlated to individual's willingness to reduce their energy use (Spence et al., 2011; Spence et al., 2012). These results suggest that the individuals who are more likely to engage in climate mediating behaviours may be the same people who perceive climate change to be a more serious risk. Therefore, having a population that is more concerned about climate change could, in turn, lead to a more successful implementation, acceptance, uptake and enforcement of climate change policies, such as those being presented in the Paris Agreement.

There is evidence to suggest that the public has become more concerned about climate change. Figure 2.2 compares the percent of participants across 22 countries who stated that climate change poses a major threat in 2013 and 2017 (Pew Research Center, 2017). There were a greater number of countries that saw an increase (Figure 2.2a) in the number of people identifying climate change as a major threat than the number of countries that saw this number decrease (Figure 2.2b). Polling data from the United States shows that the percent of Americans who are ‘very worried’ about climate change may be at an all-time high, although this is difficult to state definitively as levels of climate change fluctuate (Gallup, 2017; Leiserowitz, Maibach, Roser-Renouf, Rosenthal, & Cutler, 2017).

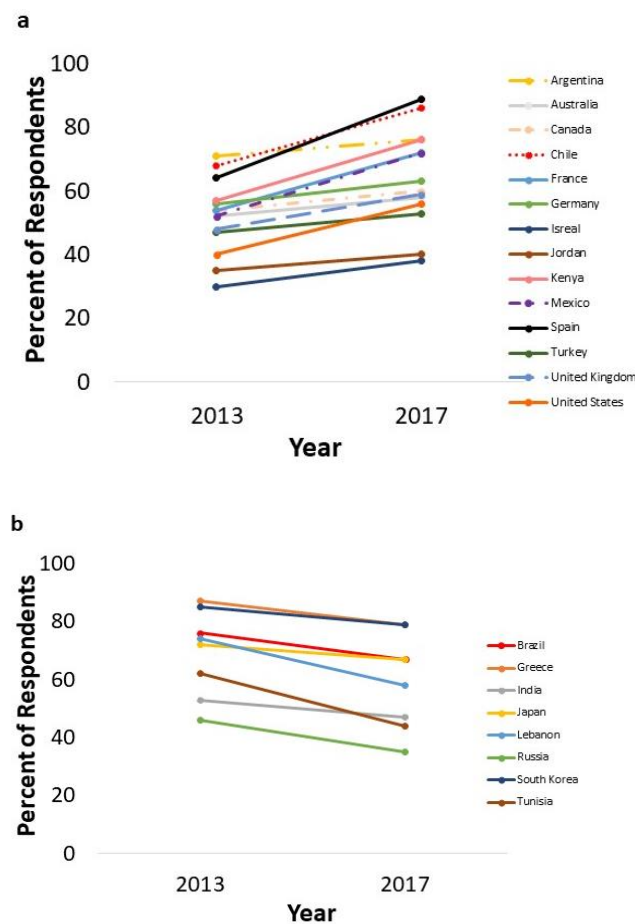


Figure 2.2: Percentage of people identifying climate change as a major threat across 22 countries with increasing (a) and decreasing (b) numbers between 2013 and 2017 (Pew Research Center, 2017).

The nationally representative study of the 'Six Americas' (N = 2129) found that in 2008, 51% of participants belonged to either the alarmed (18%) or concerned (33%) group (Maibach et al., 2009). This meant that over half of the population said they believed that climate change posed a serious threat, although they varied on their levels of personal engagement with the issue (Maibach et al., 2009). Similarly, a 2015 poll found that of 40 countries, the highest percentage of respondents who stated climate change was either 'not a problem' or 'not too serious a problem' was 30% in Israel, suggesting that overall the majority of people polled globally perceive climate change to be a threat (Pew Research Center, 2015). However, in 18 of these 40 countries, less than half of participants said they regarded climate change as being a 'very serious' problem; so while climate change may be considered to be a threat, it is possible that individuals perceive other threats to be more alarming than climate change (Pew Research Center 2015).

It is useful to consider the degree to which climate change is perceived to be a threat with respect to other risks as this may influence how individuals prioritise which threats to respond to. A 2015 poll conducted by the Pew Research Center surveying 45 435 people from 40 different countries found that of seven global threats (global climate change, global economic instability, ISIS, Iran's nuclear program, cyber-attacks, tensions with Russia and territorial disputes with China) the greatest number of people were 'very concerned' about climate change. The study also found that ranking climate change as a top threat was regional (Pew Research Center, 2015). For example, in Africa and South America climate change was the issue the greatest number of respondents were 'very concerned' about; however, in Australia, Japan, South Korea, Europe and North America the greatest number of people were 'very concerned' about ISIS (Pew Research Center, 2015, 2017). These results are in line with a previous U.K. study that found people to be more concerned with terrorism and AIDS than climate change (Lowe et al., 2006). Even amongst environmental issues, climate change has not been perceived by the British public as the most threatening (Pidgeon, Lorenzoni, & Poortinga, 2008). This suggests that while concern for climate change may be increasing in developed countries, addressing climate change may still not be the biggest priority in these countries. This could have consequences regarding whether or not resources get directed towards mitigating climate change. It is interesting to note that the Pew (2015) poll found climate change to be the issue concerning the greatest number of citizens in Brazil, India and China. This is important as these countries continue to grow as global economic powers (Hopewell, 2015). Perhaps the high levels of public concern regarding climate change in these

countries will facilitate these governments' development of their economies in a more environmentally responsible manner.

2.6. Distant threats and decision making

There may be behavioural implications if temporal distance influences the way individuals perceive climate change risk. Trope and Liberman's (2003) Construal Level Theory argues that people's judgements are affected by how soon they need to act upon their decisions. Therefore, an individual may react differently to the same event if they expect it to happen tomorrow as opposed to some point in the medium to long term future. This would suggest that climate change would be approached differently if it was perceived as a distant threat, compared to an immediate threat. This aligns with research from Israel which found that people prioritise threats they perceive to be more imminent over those they consider distant even if the distant threat is believed to be more severe (Carmi & Bartal, 2014). In their study, climate change was considered less threatening to participants regardless of how much concern it generated because it was perceived to be a distant threat (Carmi & Bartal, 2014). This suggests that individuals may be less likely to prioritise or act on threats they perceived to be distant. Trope and Liberman (2003) found that when given a choice, university students were more likely to choose to do the easy but boring assignment in the next week and the interesting but difficult assignment in a month's time despite the fact that participants would be given the materials one week in advance in both cases. The researchers suggested that for decisions made in the near future, feasibility tends to trump outcomes. Again, this implies that individuals may be more likely to procrastinate when dealing with difficult problems such as climate change in favour of solving an easier problem.

A nationally representative study was conducted in Great Britain in 2010 investigating the influence of psychological distance on levels of climate change concern and energy behaviours (Spence et al., 2012). The study took a holistic view of psychological distance including temporal, geographical and social distance as well as the effects of uncertainty (Spence et al., 2012). It found that participants who perceived climate change to be psychologically distant were less likely to be concerned about climate change (Spence et al., 2012). With respect to temporal distance, the study found that temporal distance was related to levels of concern about climate change; people who stated that climate change was already affecting the U.K, or would affect the U.K. in the next few years were more likely to be

concerned about climate change than individuals who thought it would take many years for climate change to affect the U.K. (Spence et al., 2012).

The Spence et al. (2012) study assessed temporal distance by asking participants when they expected climate change to affect the U.K. However, there are other, more subtle, ways in which temporal distance could affect individuals' assessment of climate change risk. This thesis expands on the idea of temporal distance, by proposing that the abstract nature and difficulty of visualising the distant future (Howarth, 2017; Tonn et al., 2006; Trope & Liberman, 2003) as well as future optimism, both technological (Lorenzoni et al., 2007) and otherwise (Newby-Clark & Ross, 2003; Sharot, 2011) may affect public perception of climate change risk. These aspects are discussed in detail in the following sections.

2.6.1. Difficulty visualising future consequences of climate change

Considering the potential consequences of climate change is central to the evaluation of climate change risk. One Swedish study found that people who knew the health consequences of climate change were more likely to perceive climate change as a risk (Sundblad et al., 2007). Since consequences of climate change are often reported in the timeframes of 2050 or 2100, assessing climate change risk requires the ability to imagine consequences more than 25 years away. However, people have difficulty visualising that far into the future (Tonn et al., 2006). In fact, the further into the future people imagine, the longer it takes them to visualise (D'Argembeau & Van der Linden, 2004), and the less clear the image becomes (D'Argembeau & Van der Linden, 2004; Tonn et al., 2006). This process can be further affected by age (Addis, Wong, & Schacter, 2008) and habitual emotional suppression (D'Argembeau & Van der Linden, 2006). When investigating low carbon energy futures in the U.K., Howarth (2017) reported that her participants found it difficult to visualise the year 2030, especially a low carbon 2030. If people cannot imagine what the future will look like, it will be difficult for them to evaluate future consequences of inaction.

While the near future is fairly concrete and contextualised the distant future is more abstract (Trope & Liberman, 2003). This can be amplified when people have less certainty of what their own goals will be in the future and how they, as individuals, will fit into that future (D'Argembeau & Van der Linden, 2004). Because of this, people may have a difficult time visualising the consequences of how climate change will affect their lives in the distant future. This may inhibit their ability to assess the risk of climate change, as well as their willingness to engage in mitigation. The lack of vivid imagery caused by the abstract nature of the distant future may also result in individuals discounting climate change risk (Higham, Ellis, and

Maclaurin, 2018). The generalised abstraction of future thinking may inspire procrastination as people wait for more information before making a decision (Trope & Liberman, 2003). This has implications for climate change as the cumulative nature of carbon emissions means the longer it takes to reduce emissions, the more drastic the need to reduce emissions in the future. Procrastination is likely to make it harder to mitigate climate change.

The consequences of climate change may also be more difficult to imagine compared to other risks such as terrorism because catastrophic climate change has not occurred before in living memory (Higham et al., 2018; van der Linden et al., 2015). There is a lot of evidence highlighting both the structural and behavioural overlaps between remembering the past and imagining the future (for review see Schacter et al., 2012). This has led to the theory that projections of the future are created by stringing together many past memories (Szpunar, 2010). Therefore, it may be easier for individuals to visualise a future scenario if they have memories of a similar past situation. It would follow that, concrete threats that have happened in more recent memory (such as terrorist attacks) may be easier to visualise than more abstract and unknown risks like climate change. This could explain why some people tend to rank climate change as less risky than terrorism (Pew Research Center, 2015; Lowe et al., 2006). This may also explain why people are more concerned about climate change on hotter days than on colder days (Li, Johnson, & Zaval, 2011) since on these days people are in a situation where they have extremely recent memories that they can access to help them visualise future consequences of increased global temperatures.

2.6.2. Optimism bias

Another way in which the perceived futuristic nature of climate change might influence peoples' assessment of climate change risk involves optimism. People are more likely to imagine positive futures compared to negative futures (Newby-Clark & Ross, 2003). Therefore, people may have trouble imagining climate change as a *personally* negative thing. **Optimism bias** is when an individual believes that their future will be better than their peers even though statistically and realistically it probably won't be (Sharot, 2011). It is a widespread phenomenon that has been seen in about 80% of people regardless of race, religion and age (Sharot, 2011). When university students were asked to describe their futures, Newby-Clark and Ross (2003) found that participants discussed mostly positive experiences. However, students discussed both positive and negative experiences when talking about the past. Researchers followed up this experiment by specifically asking students to imagine both positive and negative futures and found that it took participants longer to imagine negative

futures than it did positive (Newby-Clark & Ross, 2003). Students were more likely to believe positive futures would occur compared to the negative futures (Newby-Clark & Ross, 2003). Additional support for optimism bias comes from an environmental study that found undergraduate students were more likely to be optimistic about their personal futures compared to the world's future (McElwee & Brittain, 2009).

When applied to climate change, optimism bias may make people believe that the effects of climate change will not be severe or that climate change will not affect them personally (Gifford, 2011). In fact, a 2016 study found that although 69% of Americans agreed that climate change was already occurring, 52% believed it would have little to no effect on themselves personally (Yale Program on Climate Change Concern [YPCCC], 2018). Interestingly only 35% of participants thought that it would have little or no effect on other people living in the United States (YPCCC, 2018). This suggests that there are individuals who recognise that climate change will affect the United States but feel themselves exempt from these effects. A study investigating climate change perceptions within the ski industry in Queenstown, New Zealand also identified optimism bias with participants stating that climate change will affect the ski industries in other countries such as Australia but have little impact on the ski fields in New Zealand's South Island (Hopkins, 2015). This optimistic perception that an individual's future will turn out positively, despite any statistics or logic that would suggest otherwise, may make people less concerned and less willing to engage in climate change mitigation. However, tackling optimism bias is fraught as a lack of an optimism bias is linked with depression (Sharot, 2011). Therefore, there is a delicate balance between making people concerned enough about their own future to act but maintain enough hope for them to not give up (Harré, 2011).

2.6.2.1. Technological optimism

Optimism bias may also extend to technology. The belief that technology will be able to reverse or otherwise help humanity adapt to the adverse consequences of climate change may hinder individuals' ability to judge climate change risk. In the U.K., technological optimism has been identified as a barrier to engaging in climate change mitigation (Lorenzoni et al., 2007). Technological advances were also one of the reasons that society has yet to reach the limit to industrialised growth that was predicted in the 1970s due to resource shortages (Eastin, Grundmann, & Prakash, 2011). A poll of 4563 American adults conducted in 2016 found that 55% of respondents said they thought new technology will probably, or definitely, have solved most of the problems caused by global climate change in the next 50 years (Pew

Research Center, 2018). Expecting technology to solve climate change related problems could reduce the incentive for individuals to change their carbon emission behaviours. That being said, the 2015 global poll conducted by the Pew Research Center reported that 22% of participants thought technology could reduce the effects of climate change without making major life changes compared to 67% that stated major changes to lifestyle were necessary. This suggests that the majority of individuals do understand that they cannot solely rely on technological advances to mitigate climate change and that they will be required to change their behaviour in order to meet mitigation targets.

Relying on future technology to offset climate change is a gamble. First, the technology could fail to be invented in time to effectively reduce carbon emissions. Second, the technology may not be able to meet its targets (Keith, 2000). Third, the technology could have detrimental side effects (Keith, 2000). Behavioural research has shown that when gambling, people change their conceptions of probability depending on whether or not the payoff will occur in the near or distant future (Sagrignano, Trope, & Liberman, 2002; Shelley, 1994). For example, American university students were more likely to make riskier bets if the payoff was in the distant future compared to the near future (Sagrignano et al., 2002). This was true even when the gambles included loss (Shelley, 1994). Shelley (1994) explained that while people tend to discount both distant future gains and losses, compared to near future gains and losses they disregard distant losses at a greater rate. This could help explain why people are willing to gamble on technology being able to help solve climate change issues even though it is risky.

Anderson (2015) criticised the IPCC's climate change scenarios for the optimistic assumption that new climate change technology (such as *geoengineering* and other *negative emissions technologies*) will be available in the future. Geoengineering refers to technology that can intentionally manipulate the earth's climate (Corner, Parkhill, Pidgeon, & Vaughan, 2013), whereas negative emissions technologies intentionally remove carbon dioxide from the atmosphere (Fuss et al., 2014). Some examples of proposed geoengineered solutions to reduce atmospheric carbon include releasing aerosols into the atmosphere, space-based reflective shields, and carbon capturing and carbon sequestering (Keith, 2000). Including technology that may not exist in future scenarios could give policymakers an unrealistic expectation of how much mitigation is required to keep earth habitable, and thus, they may develop response plans based on inferior information. Similarly, it has been suggested that technological myths may have been used by the aviation industry to reduce the perceived need for consumer action or policy responses (Peeters, Higham, Kutzner, Cohen, & Gössling, 2016). By highlighting new

or developing technology the aviation industry can give the public the false impression that they are close to creating low carbon forms of aeromobility even though these technologies never eventuate or prove infeasible (Peeters et al., 2016) Therefore, technological optimism may negatively affect climate change risk assessments by providing individuals with unrealistic expectations regarding the extent that future technology can compensate for current high carbon habits.

2.6.3. Future affect

Judgements regarding risk perception are also influenced by affect (Slovic, 1999). However, it is unclear how temporal distance might influence affect particularly with respect to climate change mitigation. For example, the future has been shown to change the intensity of affect with people tending to overestimate how they will feel about a future event occurring (Van Boven & Ashworth, 2007). This is true for positive, negative, special and common future events (Van Boven & Ashworth, 2007). Leiserowitz (2006) found that people's affective imagery surrounding climate change is associated with their perception of climate change risk. Thus, if a person associates negative imagery of climate change then perceiving climate change as a future hazard may intensify this negative affect. While this may help increase individuals' levels of concern about climate change it could also cause people to dread the future. Dreading the future has been linked to climate change inaction (Lorenzoni et al., 2007) and so too strong an amplification could hinder mitigation.

Schwarz (2000) suggests that the reason people are bad at judging their future feelings is because they oversimplify matters and fail to take into account all the different external factors that could influence their emotions. As Van Boven & Ashworth (2007) pointed out, although this theory may be true for distant futures it cannot explain why students found the thought of re-listening to an annoying noise that they heard only 20 minutes earlier to be worse than actually listening to that annoying noise. Another hypothesis to explain amplified projections of future emotions refers to the future's abstract nature. Because the future is so abstract, people feel like they have less control over it and thus either worry or anticipate it more (Van Boven & Ashworth, 2007). However, while D'Argembeau and Van der Linden (2004) found that students described distant futures more abstractly than they do with near futures, there was no difference reported in how intensely they felt these about two futures. A related but slightly different explanation states that because the future has not happened yet it is filled with a great number of possibilities, whereas the past (which is often used in experiments as a comparison for the future) has already occurred and so the possibilities are

eliminated. Again, this may not be true as Van Boven & Ashworth, (2007) found students who were asked to imagine a hypothetical future ski trip reported more intense positive emotions than students who were asked to imagine a hypothetical past ski trip despite the fact both were imagined and so should have been filled with equal possibility. Overall, while it is possible that perceived temporal distance may amplify individuals' affective response to climate change, more research is required to uncover the extent to which this relationship exists, as well as the mechanisms behind such a relationship.

2.7. Perceived relevance and climate change risk perception

Perceptions of climate change risk may also be influenced by perceived personal relevance. Individuals who expect climate change to directly impact their lives may be more concerned about climate change. An American study found that people living near the coast were more likely to be concerned about climate change than those who lived inland (Brody, Zahran, Vedlitz, & Grover, 2008). The authors speculated that this was due to the fact that many Americans associated climate change with rising sea levels and thus they realised that climate change would affect people living in coastal cities. Similarly, U.K. residents who had flooding experience reported higher levels of climate change concern than those who had not experienced flooding (Spence et al., 2011). Flooding victims were also more likely to state that their area was susceptible to climate change (Spence et al., 2011). Unfortunately, the study did not investigate the relationship between the local area's perceived vulnerability and climate change concern; however, it is likely that the two variables are related. Awareness of vulnerability may be important as vulnerable Americans who lived in 100 year floodplains did not show an increased level of concern regarding climate change which the authors suggested could be caused by a lack of awareness that rising sea levels will also affect them (Brody et al., 2008). This suggests that making individuals more aware of how climate change will personally impact them could increase their levels of climate change concern. People may also perceive vulnerability as being relative as stakeholders in the ski industry in a popular skiing town in New Zealand identified themselves as being less vulnerable to the impacts of climate change compared to the Australian ski industry (Hopkins, 2015). Therefore, making people aware of their area's own vulnerability may be insufficient to change their perceptions of climate change risk so long as they perceive other groups to be at greater risk.

A second factor that could influence perceived climate change relevance is age. A 2016 and a 2011 survey, found that 49% of Americans (YPCCC, 2018) and 48% of U.K. citizens

(Spence et al., 2012) did not believe climate change would start harming people in their home country within the next 25 years. As such, older individuals may perceive climate change to be less personally relevant since they may not expect to live to see the impacts of climate change, although this might depend on whether they have children or grandchildren who would be affected. A Canadian study on forestry planning for the future found participants may become disengaged if scenario planning surpasses their expected lifetime (Frittaion, Duinker, & Grant, 2010). By highlighting the current or near future impact of climate change (particularly on an individual's local area) science communicators may be able to increase perceived relevance and climate change concern.

2.8. Environmental values and climate change risk perception

Individual's values shape how they receive and react to information (Kahan, Braman, Gastil, Slovic, & Mertz, 2007; Longnecker, 2016). Climate change is no exception (Kahan et al., 2012). Since climate change threatens natural environments (IPCC, 2014) it would not be surprising to discover that individuals' environmental beliefs were related to their perceptions of climate change. Studies investigating climate change scepticism in the U.K. and Australia found that environmental values were strong predictors of belief in climate change (Poortinga et al., 2011; Price, Walker, & Boschetti, 2014; Whitmarsh, 2008, 2011). Australian beliefs regarding the 'elasticity' or 'ductility' of the environment were also related to whether they said climate change is anthropomorphic in nature (Price et al., 2014). These results demonstrate that environmental beliefs influence how individuals perceived climate change but it is also possible that environmental beliefs influence how individuals perceived climate change risk. For example, there is a high chance that individuals who are sceptical of climate change perceive it to pose very little or no risk.

A New Zealand study found environmental values to be positively correlated to climate change risk perception (Milfont, 2012), and a U.K. study reported that next to direct experience with air pollution, environmental beliefs were the biggest predictor of engaging in climate mitigating actions such as taking public transport, walking or cycling (Whitmarsh, 2008). Unfortunately, the paper did not present the data supporting this claim making it difficult to verify (Whitmarsh, 2008). Environmental beliefs have been correlated to willingness to purchase an electric vehicle (EV) (Carley, Krause, Lane, & Graham, 2013; Morton, Anable, & Nelson, 2017; Plötz, Schneider, Globisch, & Dütschke, 2014). It is possible that the

environmental beliefs of these individuals influenced their perceptions of climate change risk and thus, helped inspire them to take action by moving away from petrol vehicles.

2.9. Story as a tool for communicating climate change

Given all of the factors affecting climate change risk perception discussed in the previous section and the urgent need for action, it is imperative for science communicators to develop a variety of tools to help communicate climate change. One promising instrument is story. Story may be a valuable tool for communicating climate change because it is an effective way to deliver messages. Kearney (1994) argued that story should be used to communicate climate change because it “[takes] advantage of the way people process information (pg.1).” Not only are good stories interesting and able to grab attention which is important for absorbing information, but they can also build upon the audience’s previous knowledge and present climate change on a human scale (Kearney, 1994). Interviews with Ugandan high school student found that they were more likely to seek out HIV and health information in story format than through textbooks (Mutonyi, 2016). This suggests that story may be an attractive method of accessing information. Since information that resides in unread textbooks is not useful, embedding information and messages in story might improve the chances of that information being noticed.

Delivering information through story characters may also increase message uptake. Individuals are more likely to identify climate change experts as trustworthy if they are perceived to share the same worldview (Kahan et al., 2011). It is possible that people are more likely to adopt messages from individuals whom they believe to be trustworthy and ignore information from people they believe to be less credible. Therefore, using characters who share the same worldview as the target audience may more effectively deliver climate change messages to audiences who may normally be resistant. Austrian university students reported higher intentions of changing their driving behaviours to be more climate friendly if they found the main character in a story to be trustworthy (Appel & Mara, 2013). Unfortunately, the students’ behavioural intentions did not translate into a significant change in their behavioural actions (Appel & Mara, 2013). However, it would be interesting to repeat this experiment using worldviews instead of perceived trustworthiness to see how this would change behavioural intent and actual behaviour.

Another reason story might be a useful tool for communicating climate change is that story might help people better visualise both high and low carbon futures. As discussed in

Section 2.6.1., people have a hard time envisioning the future which may influence how they judge climate change risk. One potential method of motivating people to engage in mitigation and adaptation sooner might be to show them images depicting possible futures (Nicholson-Cole, 2005; Sheppard et al., 2011). Science fiction authors like H.G. Wells, Isaac Asimov and Frank Herbert have been using narrative imagery to portray futuristic worlds for years. Story could be used as a tool for illustrating the consequences of engaging, or failing to engage, in various mitigating behaviours. In fact, climate fiction, or cli-fi, has been identified as an emerging genre in both literature (Whiteley, Chiang, & Einsiedel, 2016) and film (Svoboda, 2016).

Sheppard et al., (2011) found that when Canadians were presented with computer generated pictures of how climate change might affect their local community they were more motivated to change their behaviours. The same could be done using story. Telling individuals how climate change could affect them personally might change how relevant they perceive climate change to be. Once again, this could also influence how individuals perceive climate change risk (Section 2.7.). There is precedent for using story as a tool to help visualise the future in order to problem solve issues. For example, story-like narrative scenarios were used to help workshop participants visualise the future of forestry in Canada (Frittaion et al., 2010). Using story to depict a variety of carbon futures may help individuals visualise the consequence of different mitigation strategies and ultimately help them make decisions regarding climate change mitigation.

A third reason that story may be a useful tool for communicating climate change is its familiarity as a purveyor of moral learning. Climate change has been described as a moral issue because it will affect poorer countries and future generations that did not contribute to the problem (IPCC, 2014; Lorenzoni & Pidgeon, 2006; Shwom, Bidwell, Dan, & Dietz, 2010). However, the nature of climate change may make it difficult for some people to conceptualise it as a moral issue (Markowitz & Shariff, 2012). It may be important for people to think of climate change as a moral issue instead of an environmental issue since Americans who believe climate change to be a moral issue are more likely to support mitigation legislature (Shwom et al., 2010). Similarly, when investigating motivations behind early adopters of low carbon lifestyles in the U.K., one study found participants cited social justice and moral integrity more than environmental concern (Howell, 2013). Higham et al. (2018) argued that a significant barrier to voluntarily giving up flying is the fact that people do not consider flying to be morally problematic. Moral norms have also been shown to predict the intent of Malaysians to purchase

energy efficient appliances (Tan, Ooi, & Goh, 2017), as well as the intent of Chinese (He & Zhan, 2017) and Swedes (Nordlund, Jansson, & Westin, 2016) to purchase electric vehicles (EVs), hybrid vehicles (HEVs) and plug in hybrid vehicles (PHEVs). This supports the idea that convincing people that climate change is a moral issue would be an effective method of engaging people in climate mitigating behaviours. Since story is a familiar framework for conveying morality, story may be an effective tool for changing how individuals react to climate change and climate mitigating behaviours.

Additionally, narrative empathy (Section 1.4.2.) could make individuals more empathetic to the victims of climate change. This could be important as identification with victims of climate change may increase support of climate mitigation policies (Hart & Nisbet, 2012). Hart and Nisbet (2012) created newspaper articles to depict victims of climate change. The researchers noticed that American Republicans were more likely to sympathise with climate change victims if they were also American and less likely to sympathise if the victims were French. Hart and Nisbet (2012) suggested that this was because the Republican readers of the newspaper perceived the people in the story to have worldviews more similar to their own. However, narrative empathy may be able to extend identification with individuals beyond culture and worldviews. For example, conservative and moderate Americans who were instructed to empathise with an African child in the newspaper article they were reading were more likely to support climate mitigation policies than those who were instructed to remain objective (Lu & Schuldt, 2016). Interestingly, this study did not find perceived similarity to be an important predictor of policy support (Lu & Schuldt, 2016).

Lastly, the persuasive nature of story may make it a useful tool for communicating climate. Climate change remains controversial (Section 2.2.) but stories may be a way of encouraging pro-environmental behaviours such as those that will help mitigate climate change (Harré, 2011). The extent to which the persuasiveness of stories can influence climate change behaviours remains uncertain as most research on narrative persuasion has focused on the health field (Dahlstrom, 2014). While Kelly, Cooley, and Klinger (2014) attributed governmental action addressing ocean acidification in Washington State to the story of the Whiskey Creek shellfish hatchery in Oregon, this research is more anecdotal than empirical. Only one study was identified that directly investigated the impacts of narrative on climate mitigating behaviours (Appel & Mara, 2013). At the moment, there is a lack of information regarding narrative persuasion and its effects on inspiring climate change mitigating behaviours. It would be useful to see if different mitigating behaviours are more easily inspired

by narrative persuasion and if story is more persuasive than other forms of climate change communication such as expository text.

2.10. Mobility, system lock-in and the need for change

The previous section explained why story may be a useful tool for communicating about climate change. There are many different areas and opportunities to be communicated with respect to climate change. The focus of this thesis is mobility systems, specifically the transportation and tourism sectors. Current mobility systems are a significant generator of carbon emissions (Creutzig et al., 2015; Sims et al., 2014), and therefore must change in order to reduce global carbon emissions as agreed upon by the 2015 Paris Agreement. In 2010, 23% of all global GHG emissions were attributed to the transport sector (Sims et al., 2014). This number is likely to rise as in 2005 tourism was estimated to contribute to about 5% of GHG emissions (Peeters & Dubois, 2010) with total emissions expecting to more than double by 2035 (Scott, Peeters, & Gössling, 2010). Unfortunately, transport remains contested within discussions of climate change mitigation as neither the aviation nor maritime shipping industries were directly addressed by the Paris Agreement (Scott et al., 2016).

Since the aviation and maritime shipping industries are not scaling back despite projections estimating their growing GHG emissions will undermine global carbon reduction efforts, there is concern that policy makers are approaching climate change mitigation with a business-as-usual mind set (Becken & Mackey, 2017; Scott et al., 2016; Scott et al., 2017). However, a business-as-usual approach will not keep global temperatures below the agreed upon 1.5°C rise from pre-industrialised temperatures (IPCC, 2014; United Nations, 2015b). This sets up a potential paradox between the need for reduced carbon emissions within the transport industry and the reality of lowering carbon emissions while operating within current high carbon mobility systems. The business-as-usual approach to climate change mitigation maintains existing high carbon mobility systems instead of transitioning towards lower carbon mobility systems (e.g. the New Zealand's government investments in major road developments over redeveloping rail systems; Hopkins & Higham, 2016). This could mean favouring less disruptive end-of-pipe mitigation solutions which focus on capturing or sequestering carbon emissions over creating new low carbon transportation systems that limit the volume of emissions produced (Unruh, 2002). Yet, a 2010 review of CO₂ capture and sequestration technologies suggested that these end-of-pipe processes were an inferior way of lowering carbon emissions compared to divesting from fossil fuels (Olajire, 2010). An alternate

approach to lower carbon emissions while maintaining the current transport system is through increasing *eco-efficiency* which uses technological advances to decrease carbon emissions (Hall, 2016). To date, attention for mitigating transport emissions has mainly focused on improving eco-efficiency such as creating more fuel-efficient engines or utilising alternative fuels (Newman, 2016).

The opposite of a business-as-usual solution to climate change is a wholesale shift towards *sustainable consumption* (Hall, 2016). Sustainable consumption involves a system wide change in the way society engages and uses transport (Hall, 2016). Moving away from private car use towards increased public transport, rail, adopting new technologies (eg electric vehicles) compact cities, more local travel, and slow travel are some of the system-wide changes that could reduce total transportation emissions (Hopkins & Higham, 2016). There can be no doubt that transitioning away from the current high carbon mobility system will be difficult because of what Unruh (2000) calls the *techno-institutional complex*. Because technology and institutions develop in parallel they end up reinforcing each other (Unruh, 2000). Therefore, people find themselves locked into dominant systems not because there are no alternative technologies but because of other influencing factors such as government policy or social norms (Unruh, 2000).

System lock-in also applies to the academic discussion surrounding transport emissions mitigation and sustainability which can be constrained by the neo-liberal governmentality many researchers operate within (Schwanen, Banister, & Anable, 2011). Thus, some solutions to mitigating transport emissions may never be considered because of the lock-in of current systems. For example, Bergman, Schwanen, and Sovacool (2017) argue that the neo-liberal mentality that assumes economic growth is linked to individual car use may explain why more government, industry, consultancy, and transport coalition documents envisioning the trajectory of future low carbon mobility in the U.K. were techno-optimistic. These documents predicted that electric vehicles would be the path to low carbon mobility and ignored research suggesting that we have already reached peak car use (Bergman et al., 2017). Document predictions also overlooked the possibility that behavioural and cultural changes like car sharing may be a realistic method of decreasing carbon emissions (Bergman et al., 2017).

Boykoff and Boykoff (2007) argue that journalistic norms in the United States including personalisation, dramatization, novelty, authority-order and balance have played a large part in perpetuating confusion and climate change denial within the public sphere. For

example, in trying to provide balanced reporting media outlets gave the false impression that there was no consensus on anthropomorphic climate change when in fact this was not the case (Boykoff & Boykoff, 2007; Oreskes, 2004). Had reporters not been locked-in to a system of providing equal coverage to both sides, perhaps more people would have perceived climate change as a serious threat decades earlier (Boykoff & Boykoff, 2007).

2.10.1. Transitioning to low carbon mobility

Banister (2008) proposed four strategies to facilitate the transition to low carbon mobility: 1) reducing the need to travel, 2) shifting modes of transport through transport policy measures, 3) reducing distance through land use policy measures, and 4) increasing efficiency through technological innovations. These tactics target different stakeholders. Transport and land use policies fall within the realm of government, technological innovation is more likely to be industry driven, and reducing the need to travel might be most effectively addressed by organisations and individuals. However, there is cross-over as policies can fail without public support (Gelcich et al., 2010) and governments can help fund companies to produce their low carbon technology (e.g. Tesla Motors; Hirsch, 2015). This suggests that a holistic approach might be more effective at enabling a smoother, more rapid transition to low carbon mobility because it could reduce the barrier of system-lock in by changing the entire system.

The Energy Cultures framework (Stephenson et al., 2010) has been proposed as a tool for conceptualising the driving and reinforcing factors in mobility systems (Stephenson, Hopkins, & Doering, 2015). It suggests that practices, norms and material cultures, and external pressures shape transport cultures (Stephenson et al., 2010; Stephenson et al., 2015). The Energy Cultures framework is useful because it can be applied to different stakeholders (eg governments, industry, individuals) (Stephenson et al., 2010). As such, the Energy Cultures framework can be used to identify the factors that fall within the control of different stakeholders, providing researchers and practitioners a better understanding of how to support and facilitate the transition to low carbon mobility.

Transition management is a type of governance that tries to facilitate societal change by coordinating relevant actors at different levels (Kemp, Loorbach, & Rotmans, 2007; Rotmans, Kemp, & Van Asselt, 2001). It has been identified as one approach to transitioning to lower carbon transport systems (Kemp, Avelino, & Bressers, 2011). What is most interesting about transition management is that it targets multiple levels focusing on simultaneously changing cultures (values and social norms), structures (rules, networks, and infrastructure), and practices (routines) (Loorbach, 2010). While transition management approaches these

three spheres within a governing context it might be interesting to focus on how these spheres can address system lock-in beyond a governmental system. Bannister's (2008) suggestion to reduce the need to travel requires changes in culture (such as living closer to work and vacationing more locally), structural changes so that cities are designed such that work, schools, and shopping are within walking distance, and changes in practices including walking or cycling to work instead of driving. Governments may be best suited for controlling the structural aspects that work to support these changes, but the cultural changes and changes in practices might need to come from decisions made at an individual and societal level.

2.10.2. Public expectations of future travel

An important factor that needs to be considered when attempting to transition towards lower carbon mobility systems is how the public — everyday users and contributors to travel emissions — foresee the future of travel. Burstein's (2003) review of 30 papers published between 1980-2000 found that public opinion affected policy approximately 75% of the time and that it had a substantial influence on policy about 35% of the time. The report also cautiously suggested that public opinion remained a significant influencer of policy even in the presence of special interest groups and political parties (Burstein, 2003). This may be important considering the vested interest oil companies have in prolonging current high carbon mobility systems. Because the public functions both as consumers who can help drive the market and citizens who can influence government policies, understanding people's hopes for and expectations of future travel offer important insights into possible pathways to low carbon mobility systems.

Another reason it is important to include non-expert opinions in the creation of desired future transport scenarios is that their outsider status could allow for new and more innovative ideas (Tuominen, Tapio, Varho, Järvi, & Banister, 2014). This could be because the public is more likely to focus on desired futures while practitioners, decision makers, academics, and theorists focus on what they think is likely to occur (Soria-Lara & Banister, 2017). Bergman et al. (2017) describe future visions as important tools for the transition to low carbon mobility as they can help initiate and fund projects, create interest, attract resources, and even shape innovation pathways if they become the collectively accepted desired future. Including members of the public in the creation of these future visions may also help bridge the 'implementation gap' (Soria-Lara & Banister, 2017).

Investigating expectations of future travel will help identify inconsistencies between public expectations of future travel and what is realistic in terms of low carbon emissions.

Peeters et al. (2016) reviewed how daily print media from 1994-2013 reported proposed technological solutions to reducing emission within the aviation industry and found that most of these solutions were either impossible or impractical, had been abandoned by the industry, or that their ability to reduce emissions had been overstated. The authors suggested that promises of technological solutions to mitigating emissions may perpetuate the myth of an environmentally sustainable aviation industry (Peeters et al., 2016). They argue the existence of these ‘myths’ such as sustainable aeromobility influence the public’s expectations of future travel and willingness to engage in transitions to low carbon mobility systems (Peeters et al., 2016). A Finish study asked high school students to write a one-page essay on what future transport would look like in the year 2020 or the year 2050 found students provided more radical depictions of future transport due to major technological innovations compared to experts (Tuominen et al., 2014). This radical depiction required less behaviour change than other visions of the future that were proposed in the same study (Tuominen et al., 2014). Therefore, it is important to identify unrealistic expectations that the public may have regarding future travel so that these misconceptions can be addressed accordingly.

2.11. Positioning of this thesis within the existing literature

A number of interesting gaps were identified after critically reviewing the literature surrounding science communication, climate change communication, risk assessment, storytelling, mobility systems and futures. First, story has been proposed as a tool for communicating climate change (van der Linden et al., 2015); however, there has been little empirical research testing its use (Appel & Mara, 2013). Thus, one aspect of this research thesis is to empirically test story as a tool for communicating about climate change. Second, whether climate change is perceived to impact the near or distant future has been identified as an influencer of climate change risk perception (Gifford, 2011; Leiserowitz, 2005; Spence et al., 2012; van der Linden et al., 2015), but these studies have not tested how time related factors such as individuals’ ability to visualise the distant future and optimism bias may influence levels of concern about climate change. This thesis identified the year 2050 to represent the distant future. The year 2050 is appropriate because it is far enough in the future that people may find it difficult to visualise (Tonn et al., 2006), it was used as a reference point in the latest IPCC (2014) report on climate change, and it is not necessarily beyond participants’ lifetimes thereby potentially increasing its personal relevance (Frittaion et al., 2010).

Third, there appear to be no studies exploring how story might mitigate the influence of temporal distance on climate change risk perceptions by helping individuals visualise the future. This thesis takes advantage of this by testing the influence of a story set in the year 2050 on participants' expectations of the future. The fact that mobility systems are tangible and directly related to climate change made it an ideal context for exploring expectations surrounding the future and climate change mitigation. As a result, mobility systems — specifically the transition to low carbon mobility — was selected as the vehicle for exploring climate mitigated futures. These four under-researched areas within the literature provided the research opportunity used when designing this thesis' overarching aim, objective and research questions (Box 1).

2.12. Research aims, objectives and guiding questions

This thesis aimed to explore story as a tool for climate change communication by investigating the influence of story on individuals' perceptions of climate change risk and future mobility systems. The first research objective was to investigate the influence of story on the relationship between climate change risk perception and temporal distance. This inquiry was guided by the first two research questions (Box 2.1). The second research objective examined story's influence on the relationship between levels of climate change concern and expectations of mobility systems in the year 2050. The third, fourth and fifth research questions were used to steer this line of investigation (Box 2.1).

Box 2.1: Research Questions

Research question one: Does temporal distance influence individual's levels of climate change concern?

Research question two: Can story help individuals visualise the distant future?

Research question three: Are expectations of travel in 2050 consistent with the notion of a low carbon mobility future?

Research question four: Are individuals' expectations of travel in 2050 related to their levels of climate change concern?

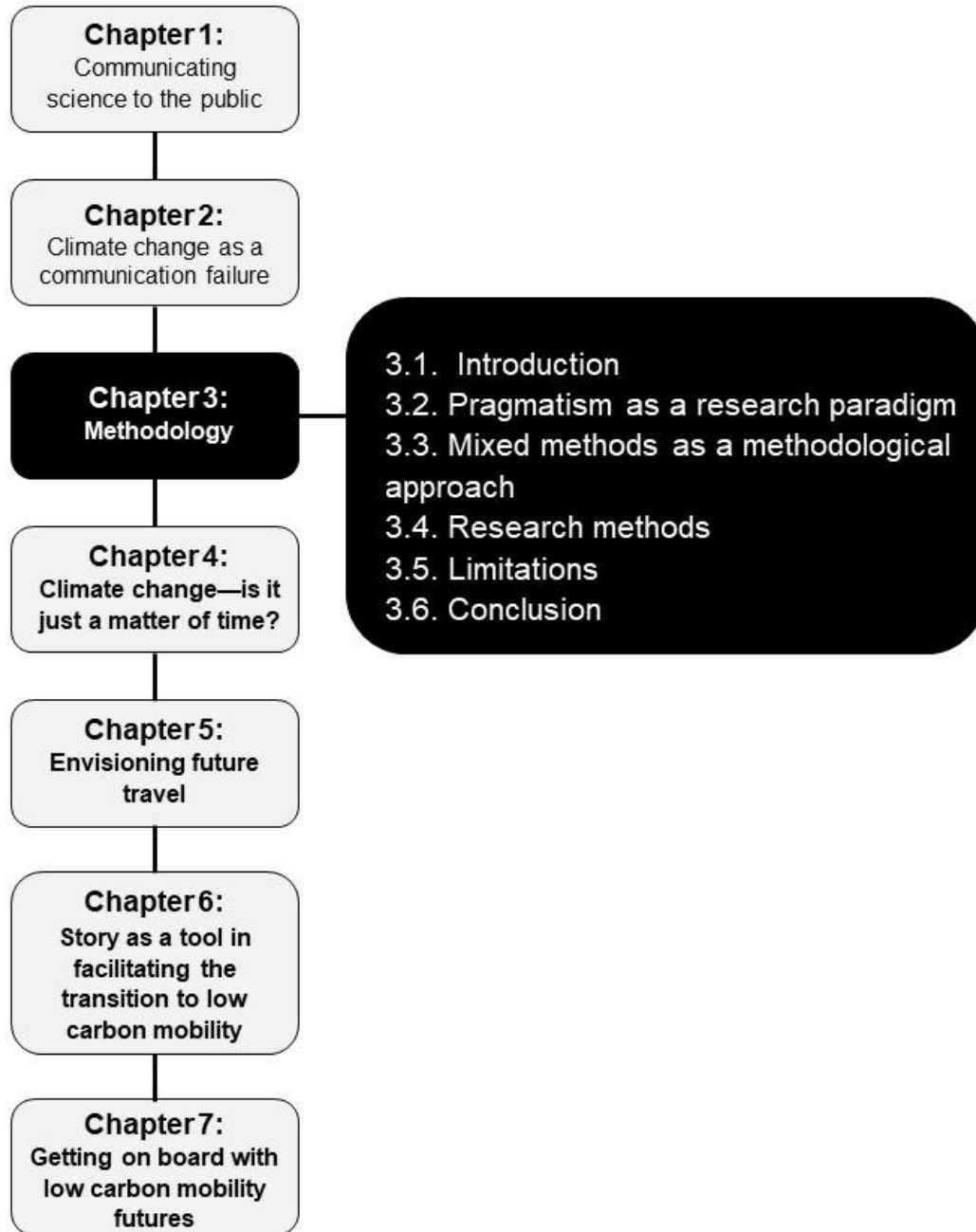
Research question five: Can a short story influence participants' expectations of travel in 2050 to make them more consistent with the idea of a low carbon mobility future?

2.13. Conclusion

This thesis takes climate change as a timely example of an urgent scientific issue that is problematic to communicate to the public. Specifically, it uses expectations of future travel

to explore gaps in the literature surrounding story, climate change risk perceptions, temporal distance, and the transition to low carbon mobility futures. Stories can portray distant futures which may help people visualise and contextualise distant climate change futures that would otherwise be abstract and hard to imagine. As a result, story could be a useful tool for mitigating the influence that perceived temporal distance may have on climate change risk perceptions. The persuasive nature of stories may also be able to change individuals' expectations of future travel so that they align with the notion of a low carbon mobility future. However, the empirical evidence to date offers mixed results as to whether or not stories can influence perceptions of risk probability. The next chapter describes the underpinning paradigm, methodology and research methods that were used to test the influence of temporal distance and story on individuals' perceptions of climate change risk and expectations of travel in the year 2050.

Chapter 3: Methodology



3.1. Introduction

This thesis aims to explore how story can be used to communicate about climate change. It investigates whether reading a short story can change participants' perceptions of travel in the year 2050 and climate change risk. Chapter Three outlines the underlying ideology, methodology and specific research methods used to inform, collect and analyse the data that addresses the research aim. The chapter begins by considering the nature of knowledge and how that influences the type of data that can be collected by the researcher. It then explains the reasoning behind why each instrument was selected. The decisions pertaining to how these instruments were designed are explained and justified. This includes details regarding which research questions are addressed by each instrument. The chapter also describes the research participants and how they were recruited. Lastly, the data cleaning process and methods of analysing the data are discussed.

3.2. Pragmatism as a research paradigm

There are four main ways that the term paradigm is used in the social science literatures—to represent a worldview, an epistemological stance, a set of shared beliefs in a research field, or model examples (Morgan, 2007). The commonality between the first three definitions of paradigm is the idea that researchers need to acknowledge their assumptions regarding knowledge and reality. This is important because a researcher's ontology (beliefs about the nature of reality) and epistemology (beliefs about the nature of knowledge) will determine the way data are collected and interpreted (Braun & Clarke, 2006; Feilzer, 2010; Twining, Heller, Nussbaum, & Tsai, 2017). For example, a positive paradigm assumes there is one measurable reality while a constructivist paradigm assumes there are multiple realities and that knowledge is socially constructed and defined by culture (Creswell, 2013; O'Learly, 2010; Teddlie & Tashakkori, 2009). Therefore, stating the paradigm that guides the research clarifies what types of meanings can or cannot be drawn from the research.

One limitation of designing research studies based upon a philosophical paradigm is that it may be difficult to generate a holistic understanding of the phenomenon since accepting one paradigm (for example constructivism) automatically forces you to dismiss research findings from competing paradigms (such as positivism) (Morgan, 2007). To avoid the forced duality associated with traditional philosophical paradigms, researchers

have increasingly turned to pragmatism as an alternative paradigm (Biesta, 2010; Feilzer, 2010; Johnson & Onwuegbuzie, 2004; Morgan, 2007; Padgett, 2004; Teddlie & Tashakkori, 2009). The main reason that pragmatism was selected as the guiding research paradigm in this research thesis (Figure 3.1) was because it argues that research should be designed around the research question (Creswell, 2013). The interdisciplinary nature of this research thesis meant that a paradigm was required that could accommodate interdisciplinary research methodologies. Pragmatism allows for the exploration of different layers of a complex phenomenon using whichever methodologies are deemed most appropriate; it does not restrict researchers to using only qualitative or only quantitative research methodologies (Feilzer, 2010; Padgett, 2004). Pragmatism rejects the traditional idea that reality is either objective or subjective and instead accepts the notion that there can be both an objective as well as subjective reality (Creswell, 2013; Johnson & Onwuegbuzie, 2004; Teddlie & Tashakkori, 2009). Under pragmatism it is possible for climate change to be both objectively measurable and culturally defined.

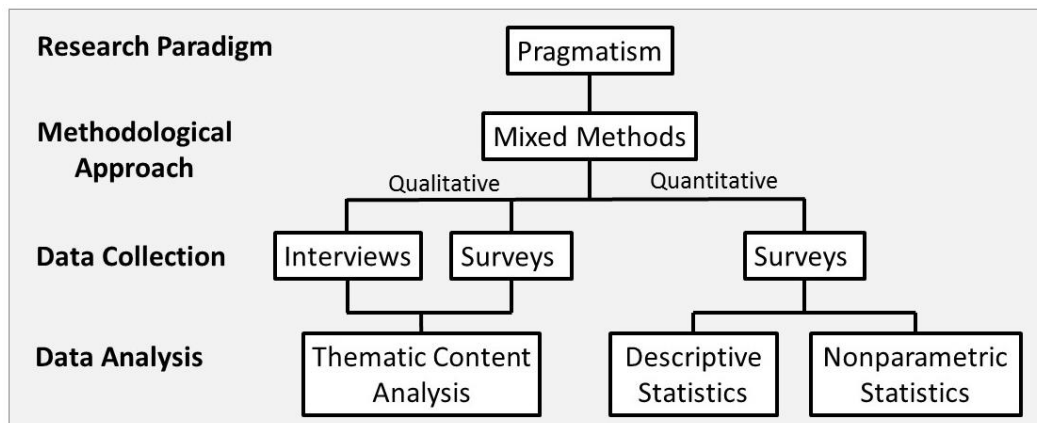


Figure 3.1: Illustrative summary of the research design employed in this thesis

One of the reasons that positivism was an inappropriate paradigm for this research was because it argues that there is only one, knowable reality (Leong, 1985). This thesis deals with predictions of the future and since no one can definitively know what will happen in the future, the explanatory nature of positivism is fundamentally at odds with futures research (Aligica, 2003). This thesis leans towards the constructivist view in which individuals and groups create their own meanings (Cupchik, 2001) as this can help explain why some people believe in facts while others believe in ‘*alternative facts*’

(McCright & Dunlap, 2017). However, this thesis also maintains that physical phenomenon like gravity would continue to exist independently of cultural constructs.

Pragmatism focuses on the practical consequences of holding a belief (Johnson & Onwuegbuzie, 2004). For example, pragmatism would be concerned about how holding a particular belief about future travel result would or would not result in a transition to low carbon mobility. Thus, pragmatism considers the real-life consequences of the research (Feilzer, 2010). Additionally, pragmatism does not try and discover a universal truth, only what works at a certain time for a particular context (Padgett, 2004; Teddlie & Tashakkori, 2009). A major component of this research thesis is empirically testing a story intervention. The idea of a contextualised, reality-based paradigm aligns with the goal of collecting knowledge to help develop useful interventions. For these reasons, pragmatism was identified as the most appropriate paradigm to guide this research thesis.

3.3. Mixed methods as a methodological approach

The previous section explained that pragmatism advocates utilising question appropriate methodologies. Research questions two through five (Box 1) required investigating participants' perceptions of travel in the year 2050 (Table 3.1). ***Inductive qualitative methodology*** was the most appropriate methodology for enabling a more inclusive understanding of these expectations (Creswell, 2013). At the same time, ***quantitative methodology*** was better suited to identifying potential relationships between variables (eg. levels of climate change concern, ability to visualise the future, optimism, environmental beliefs), a requirement that was needed to answer the first three research questions (Creswell, 2013). Since both qualitative and quantitative methodologies were identified as being appropriate for addressing different sections of the research, a mixed methods approach was selected as the methodology that was best suited for exploring the research topic as a whole (Figure 3.1) (Creswell, 2013; Johnson & Onwuegbuzie, 2004; O'Learly, 2010).

Johnson and Onwuegbuzie (2004) defined mixed methods research “as the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study” (pg 17). Mixed methods can be both inductive and ***deductive***, taking meaning from participants to generate theories, as well as testing theories and relationships between variables (Creswell, 2013, 2014; Johnson & Onwuegbuzie, 2004). The advantages of mixed

methods are that the limitations of one methodology can be compensated for by using a different, complementary methodology (Johnson & Onwuegbuzie, 2004; O'Learly, 2010). For example, quantitative data tends to be more generalisable but can lack context, whereas qualitative data is rich in context but may be less generalisable (Johnson & Onwuegbuzie, 2004). To overcome these limitations a researcher can use quantitative methodology to identify a general trend and then follow-up with qualitative methodology to provide in-depth contextual understanding of the phenomenon (Creswell, 2014). Alternatively, the researcher can identify a phenomenon through an in-depth qualitative approach and then test its generalisability through quantitative methods (Creswell, 2014). Mixed methods also allow a researcher to consider a phenomenon from multiple perspectives (O'Learly, 2010). By mixing qualitative and quantitative methodologies researchers can obtain a more holistic understanding of a phenomenon (Feilzer, 2010).

This research thesis was conducted in three phases (Figure 3.2). The first phase investigated the impact of story on perceptions of climate change risk and perceptions of future travel. In order to understand this relationship, qualitative and quantitative data were collected simultaneously. A benefit of this type of convergent mixed methods design was that it provided a method of triangulation by collecting and analysing quantitative and qualitative data separately and then drawing meaning from the integration of these independent findings (Creswell, 2014). The second phase of the research investigated the role of temporal distance in judging climate change risk. This study was informed by results from the first phase while simultaneously employing a convergent mixed methods design. The third phase of the research explored the longer-term impacts of story. It used an explanatory sequential mixed method design in which the quantitative results collected in phase one were built upon with qualitative follow-up that more deeply explored the preliminary findings (Creswell, 2014). Explanatory sequential design can be useful for understanding and contextualising quantitative results (Creswell, 2014).

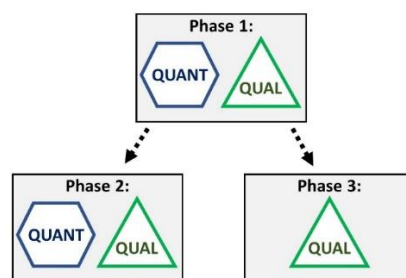


Figure 3.2: Methodology used in the three phases of this research thesis

3.4. Research methods

3.4.1. Data collection

3.4.1.1. Surveys

The first two research phases required simultaneously collecting qualitative and quantitative data from participants (Figure 3.2). Surveys were an ideal method for collecting data in these first two phases because they can capture both quantitative and qualitative data (Figure 3.1, Table 3.1) (O'Learly, 2010). Other methods, such as focus groups are not conducive to collecting quantitative data. For example, the purpose of a focus group is to share experiences and create discussion (Martin & Hanington, 2012; O'Learly, 2010). Additionally, individuals in focus groups can be influenced by the opinions of other members making it difficult to identify their original perceptions of travel in the year 2050 (Dawson, 2006). Benefits to collecting data through surveys include the fact that: between governmental census, opinion polling and market research, surveys are a format that is very familiar to people (Fowler, 2014), answers between respondents are comparable (Fowler, 2014; O'Learly, 2010), surveys can collect the large data set required to identify generalisable trends (Creswell, 2013; O'Learly, 2010), and there is a short turnaround time (Lefever, Dal, & Matthiasdottir, 2007). However, one limitation to collecting participants' perceptions of future travel through a survey is that it is more difficult to get an in-depth understanding on the reasons behind why their expectations of future travel may or may not have changed (O'Learly, 2010). To compensate for this limitation, interviews were used in the third phase of the research.

Table 3.1: Methodologies and methods used to address the research questions

Research Question	Data Type Required	Data Collection Method
Does temporal distance influence individual's levels of climate change concern?	Quantitative Qualitative	Survey
Can story help individuals visualise the distant future?	Quantitative	Survey
Are individuals' expectation of travel in 2050 related to their levels of climate change concern?	Quantitative Qualitative	Survey
Are expectations of travel in 2050 consistent with the notion of a low carbon mobility future?	Qualitative	Survey Interview
Can a short story influence participants' expectations of travel in 2050 to make them more consistent with the idea of a low carbon mobility future?	Qualitative	Survey Interview

There were two main reasons that online surveys were selected over paper based surveys—convenience and control over the question order. For participants, online surveys involve less effort as they are not required to mail the survey back (Lefever et al., 2007). Additionally, the online platforms that were used to host the two surveys (SurveyGizmoTM and SurveyMonkeyTM) were designed to be accessible on multiple types of devices (computers, tablets, phones), allowing participants to complete the survey on whatever device was most convenient for them. From a researcher's perspective, the online format saved time as responses did not need to be manually uploaded (Evans & Mathur, 2005). This direct storage of data in a digital format also helps minimise input error (Lefever et al., 2007). Another advantage of the online survey was that it could be set up so that respondents answer questions in a specific order (Evans & Mathur, 2005; Sue & Ritter, 2012). In terms of this research thesis, participants were shown questions related to climate change only after they had been asked about their expectations of travel in the year 2050. This helped to decrease the chance that participants' answers regarding their expectations of travel in the year 2050 were primed towards climate change. Lastly, it was estimated that in 2017 81% of people in developed countries were using the internet with 84% of households having internet access at home (International Telecommunications Union, 2018). This suggests that it is unlikely that most people would be excluded from participating due to internet access issues.

3.4.1.2. Interviews

The third phase was designed to explore the longer-term impacts of the interventions presented during the first phase. This phase examined the influence the texts had on participants' experiences subsequent to taking part in the survey. Qualitative methodology was best suited to addressing this question (Table 3.1). Therefore, the method chosen to collect data in the last phase of the research did not need to capture quantitative data. Interviews provide a way of exploring how individuals experience the world around them (Brinkmann & Kvale, 2015; Seidman, 2013). Brinkmann and Kvale (2015) describe interviews as “a conversation that has a structure and a purpose” (pg. 5). This research thesis used a semi-structured interview format because it offered enough structure to ensure specific themes and questions were addressed within the interview so that comparisons could be made between participants, while still allowing enough flexibility to respond to the interviewee with follow-up questions (Brinkmann & Kvale, 2015; Dawson, 2006; Salmons, 2015). It also allowed for changes to the question order

to suit the flow of the interview (Brinkmann & Kvale, 2015). One reason that a survey was not selected to collect data about the longer-term effects of the texts was because surveys can only capture the questions asked in the survey while semi-structured interviews can reveal important information and tangents that the researcher may not have thought to ask (Dawson, 2006; O'Learly, 2010). Focus groups are a specific type of interview (O'Learly, 2010) but the internationally dispersed nature of participants in the studies would have made organising focus groups expensive, inconvenient and challenging. In order to maximise participant convenience, they were given the choice of being interviewed online, over the telephone or in person.

3.4.1.3. Instrument design

Story Survey design. The first phase of the research used an online survey, hereafter referred to as the Story Survey, to investigate the immediate impacts of a story on participants' perceptions of travel in the year 2050 (Appendix A). The Story Survey addressed the second, third, fourth and fifth research questions (Table 3.2). Since this survey was testing the impact of a short story intervention, the survey was designed to model a pre-test/post-test format. The first half of the survey functioned as the pre-test where participants were asked a series of questions about their ability to visualise the future, expectations of future travel and perceptions of climate change risk (Appendix A). Next participants were randomly given one of two interventions. Depending on the intervention, participants were asked to read either a short story (Appendix B) or an expository textbook styled excerpt (Appendix C). The intervention assignments were made by SurveyGizmoTM, the platform which hosted the survey. The final part of the survey acted as a post-test, repeating many of the questions from the first half of the survey (Appendix A).

Identically worded questions were used in both the pre- and post-test sections of the survey to increase researcher confidence that any observed changes in participants' responses were due to the intervention and not a result of interpreting the pre- and post-questions differently. There is precedent for using identical questions in pre- and post-testing in the literature (e.g. Fernández-Llamazares et al., 2015; Jandorf et al., 2012; Schoeps, Tallberg, & Gunningberg, 2017; Sokoloff, Laws, & Thornton, 2007; Vannice et al., 2011). The following statement: "*Although some of the questions may be similar, for the purposes of this research it is important to answer all the questions to the best of your ability*" was shown to participants before they began the post-test section of the Story

Survey. This statement was included in expectation of the fact that participants might find the repetition of questions annoying and exit the survey early. There was a high dropout rate (40%) in the first four days following the launch of the Story Survey. In response, the original statement was modified on Feb 29, 2016, to read “*Some of these questions are repeated intentionally. Sorry if it’s annoying, but please answer them again. Thank you!*” and was placed at the top of the page before each repeated question. After this, the dropout rate decreased to 25%.

Table 3.2: Relationship between Story Survey question, type of data collected, topic and research question (Appendix A)

Research Question	Topic	Data Type Required	Questions
Can story help individuals visualise the distant future?	Visualising distant future	Quantitative	6, 7, 18
Are individuals’ expectation of travel in 2050 related to their levels of climate change concern?	Climate change risk	Quantitative	10, 11, 12, 14, 21, 22, 23, 25
		Qualitative	13, 15, 24, 26
	Future expectations of travel	Quantitative	8, 19
		Qualitative	9, 13, 20, 24
Are expectations of travel in 2050 consistent with the notion of a low carbon mobility future?	Future expectations of travel	Qualitative	8, 9, 19, 20
Can a short story influence participants’ expectations of travel in 2050 to make them more consistent with the idea of a low carbon mobility future?	Future expectations of travel	Qualitative	8, 9, 19, 20

There were other important considerations that informed the design of the Story Survey. First, various styles of questions were used including multiple choice questions, Likert scale questions and open-ended questions. An open-ended question was used to explore participants’ perceptions of travel in the year 2050. This was done to prevent answers from being restricted by predetermined categories that may not have been reflective of participants’ beliefs (Braun & Clarke, 2006; Johnson & Onwuegbuzie, 2004). Second, the third research question wanted to know whether individuals’ expectation of travel in 2050 were related to their levels of climate change concern. In an attempt to avoid influencing these results by accidentally priming participants to be

thinking about climate change when they considered future travel, the questions asking participants about their levels of concern about climate change were asked after the questions about expectations of future travel (Appendix A).

Third, in order to compare participants' answers with previous findings many questions in the Story Survey were taken or adapted from other studies. For example, participants' ability to visualise the future was measured using a question developed by Tonn et al. (2006) in which participants self-reported how clearly they could visualise different timeframes. The Story Survey also added a question asking participants to identify how clearly they could visualise the year 2050 specifically. Three separate studies informed development of the instrument that measured participants' perceptions of climate change risk (Lowe et al., 2006; Nisbet & Myers, 2007; Pew Research Center, 2015). It should be noted that Lowe et al.'s (2006) original study asking participants to rank global threats also included poverty as a global threat. This threat was accidentally dropped from the Story Survey due to a copy error.

Lastly, demographic information was collected to provide a basic understanding of the population that was surveyed. It was thought that some of the demographic data might help predict how people perceive climate change risk. For example, an American study found women tended to be more concerned about climate change (McCright, 2010). It was also thought that older generations may be less concerned about climate change since they might not expect to live to see the consequences of climate change (Frittaion et al., 2010; YPCCC, 2018). Demographic information collected included participants' age, gender, nationality and level of education. One challenge with creating the education categories is that different nationalities have different systems and terminology for various levels of education. Thus, multiple terms were used. The age range categories were created to be compatible with international census data (United States Census Bureau, 2011; Stats NZ, 2013).

Intervention design. A story intervention was created to test the impact of reading a short story on participants' expectations of travel in the year 2050 (Appendix B). To account for the fact that any resulting changes in participants' expectations could be due to the presence of new information and not the story format itself, an expository textbook styled intervention was also created (Appendix C). Participants read either the story or the textbook intervention. The first important creative decision that was made regarding the interventions was how to portray the year 2050. The thesis explored participants perceptions of both future travel and climate change risk; therefore, it was

imperative to determine how low carbon mobility and climate change would be described in the interventions (Appendix D and E). A number of ideas (key elements) were taken from the literature regarding modes of possible low carbon mobility futures (Table 3.3, Appendix D and E).

Within the idea that there would be less international travel (Table 3.3) was the idea that international would be less common in younger generations (Ceron & Dubois, 2007). Because this research was comparing the impacts of two different interventions, it was important that the same information was presented in both texts. Table 3.3 provides examples of how the seven key elements were conveyed within each text. Due to the natures of narrative and expository styled texts, the story intervention was longer (~1500 words; Appendix B) than the textbook intervention (~500 words; Appendix C).

Harré (2011) recommended aiming high and depicting the ideal world that the storyteller wishes to enable when creating stories about sustainable futures. It was thought that some ideas regarding the transition to low carbon mobility may be more readily adopted by participants than others. To test if there were limits to what participants would be willing to accept, the story and textbook interventions suggested that very few people would still be using personal vehicles in 2050 instead of describing a future where people were using electric or alternatively fuelled person vehicles. The drastic reduction of cars was deemed a more extreme transition solution compared to the idea that there would be an increase in public transport.

It was decided that climate change would not be portrayed in the interventions as having post-apocalyptic effects on New Zealand (Table 3.4). This was because this depiction would not be consistent with current predictions of how climate change is expected to affect New Zealand in 2050 (New Zealand Climate Change Centre, 2010; Ministry for the Environment, 2017). Unrealistic depictions of climate change may make individuals dismissive of climate change messages (Lowe et al., 2006). The intent of the intervention was not to paint such a depressing picture of 2050 that people dreaded the future. Research by O'Neill and Nicholson-Cole (2009) noted that using fear or negative depictions of the future fail to engage people with climate mitigation. Similarly, Harré (2011) discussed the importance of eliciting more positive emotions than negative emotions when trying to get people to act sustainably.

Table 3.3: Key travel elements, inspiring literature and examples of element integration in the story and textbook interventions.

Key Travel Element	Literature Sourced	Example of Element Integration	
		Story Intervention	Textbook Intervention
Greater use of trains, and public transit	Ceron & Dubois, 2007; Newman, Kenworthy, & Glazebrook, 2013	Luckily there were a number of bus and train stations along the route.	... increased government investment in public transit infrastructure across the country created a lattice of connecting bicycle paths, buses and trains that further supported the growth of slow travel in New Zealand by making it more easy and accessible for travellers to use.
More bicycling	Harré, 2011; Pucher & Buehler, 2017	We raced through town earning at least one or two angry glares as we weaved around the local cyclists completing their Saturday morning errands.	
Less driving	Newman & Kenworthy, 2011; Peeters & Dubois, 2010	Who still drives a car?	...also contributed to the decrease in personal car ownership.
Flights more expensive	Ceron & Dubois, 2007; Yeoman, 2012	He still hasn't forgiven me for going to America for six months. But really, since one can only afford to fly once every ten years these days you might as well stay for a while.	Since flying has become so expensive most of these pensioners can only afford to fly about once every ten years.
Less flying	Ceron & Dubois, 2007		
Less international travel/ more local travel	Peeters & Dubois, 2010; Yeoman, 2012	No one in our generation would admit to flying so far away just for a holiday.	...people began trading their international holidays for local trips.
Slower travel	Dickinson, Lumsdon, & Robbins, 2011	<i>Not explicitly mentioned but implicitly described</i>	Another major shift in the tourism industry was the popularization of the slow travel movement...

There were a number of deliberate stylistic decisions that were made during the construction of the story intervention to try to increase the persuasiveness of the short story (Appendix D). Since subtlety increases narratives persuasion (Moyer-Gusé & Nabi, 2010), low carbon mobility was not the main focus of the story. Instead, the story intervention centred around three protagonists chasing their favourite band around New Zealand (Appendix B and D). Meanwhile, the textbook intervention described the hypothetical future rise of slow travel within New Zealand (Appendix C and E). Moyer-Gusé and Nabi (2010) found that the more people related to the characters in a narrative the less likely they were to argue with the messages presented within the story; thereby, increasing the chances of message adoption. As a result, the story intervention was written as a first person narrative with an unnamed, ungendered main character in an attempt to make the character more relatable to participants.

Table 3.4 Inspiring literature and example of how climate change was depicted in the story and textbook interventions.

Effects of Climate Change	Literature Source	Example of Element Integration	
		Story Intervention	Textbook Intervention
Storms and flooding are an expected consequence of climate change in New Zealand	New Zealand Climate Change Centre, 2010; Ministry for the Environment, 2017	The last few weeks had been quite stormy and I really didn't want to return home and find my basement apartment flooded again.	While the last few years of increased storms around New Zealand's South Island has slightly influenced tourists' cycling habits, slow travel continues to grow.

Temporal Distance Survey design. Results from the Story Survey in the first phase of the research showed that participants often discussed technological solutions to mitigating travel emissions (see Section 5.3. for details). Based on this information, a second online survey, hereafter referred to as the Temporal Distance Survey, was designed to explore the potential role that technological optimism and other temporally distant factors might play in participants' assessment of climate change risk (Appendix F). The Temporal Distance survey addressed the first, third and fourth research questions (Table 3.5).

Table 3.5: Relationship between Temporal Distance Survey question, type of data collected, topic and research question (Appendix F)

Research Question	Topic	Data Type Required	Questions
Does temporal distance influence individual's levels of climate change concern?	Ability to visualise the future	Quantitative	6
	Optimism	Quantitative	9
Are individuals' expectation of travel in 2050 related to their levels of climate change concern?	Climate change risk	Quantitative	10, 11
	Future	Quantitative	7
	expectations of travel	Qualitative	8
Are expectations of travel in 2050 consistent with the notion of a low carbon mobility future?	Future	Quantitative	7
	expectations of travel	Qualitative	8

As in the Story Survey, questions in the Temporal Distance Survey varied in style including multiple choice, Likert scale and open-ended (Appendix F). To minimize the dropout rate, the Temporal Distance survey was significantly shorter than the Story Survey. For consistency, the wording for the questions assessing participants' ability to visualise the future, expectations of future travel and perceptions of climate change risk

Table 3.6: Likert questions and sources used to measure optimism, technological optimism, environmental and societal beliefs

Topic	Statement	Source	Reference
Optimism	• I rarely count on good things happening to me	The Live Orientation Test Revised	Scheier, Carver, & Bridges, (1994)
	• I am always optimistic about my future		
Technological optimism	• Advancing technology provides us with hope for the future	Dominant Social Paradigm	Kilbourne, Beckmann, & Thelen, (2002)
	• Future resource shortages will be solved by technology		
Environmental and societal beliefs	• Humans have the right to modify the natural environment to suit their needs	The New Environmental Paradigm	Dunlap & Van Liere, (1978)
	• There are limits to growth beyond which our industrialised society cannot expand		
	• Business interests have more political power than individuals	Dominant Social Paradigm	Kilbourne, Beckmann, & Thelen, (2002)

in the Temporal Distance Survey were copied from the Story Survey (Appendix A and F). This meant that the questions measuring perceptions of climate change risk were inspired by optimism, attitudes towards technology as well as environmental and societal beliefs were also taken from the literature (Table 3.6). Again, this enabled participants' responses to be compared to the literature. Lastly, demographic data were collected through four quantitative questions investigating age, gender, nationality and level of education. This helped to understand who was participating in the study.

3.4.1.4. Reliability and validity

For research to be useful, there needs to be a high level of confidence that the results accurately reflect the phenomena being investigated (Bazeley, 2013). Quantitative research addresses this through the twin concepts of validity and reliability, where validity refers to the ability to accurately measure the intended phenomena and reliability refers to the ability to replicate results (Golafshani, 2003). There are three types of validity in quantitative research (Creswell, 2013). Content validity refers to determining how representative the questions are of the phenomena being studied (Creswell, 2013; Pallant, 2016). Reviewing and drawing from the literature increased the content validity of both the Story Survey and Temporal Distance Survey. Similarly, using and adapting existing questions from the literature allowed for external comparison, increasing the surveys' criterion validity (Creswell, 2013; Pallant, 2016). Another benefit of using established questions like those from the New Environmental Paradigm is that their validity and reliability has already been confirmed (Milfont & Duckitt, 2010). The third type of validity, construct validity, refers to whether questions actually measure what they claim to measure (Creswell, 2013; Pallant, 2016). To minimise the chance that questions in the Story Survey would be misunderstood by participants a small pilot study ($n = 6$) was run (Bazeley, 2013), followed by one-on-one discussions regarding the survey.

One method of testing reliability is through analysing internal consistency (Pallant, 2016). Multiple questions were used to collect the same information which allowed for internal consistency to be assessed. Sometimes these questions had different formats (Fowler, 2014) or framings. In some cases, the framing of the question was flipped to ensure both positive and negative statements were present (e.g. *Future resource shortages will be solved by technology* was changed to read *future resource shortages will not be solved by technology*). Due to the small number of questions used for each

category, mean inter-item correlations were used to calculate internal consistency (Pallant, 2016) (Appendix G).

Qualitative research often uses the concepts of credibility, transferability, dependability, and confirmability to judge the trustworthiness of research (Decrop, 2004; Golafshani, 2003). Like reliability, internal consistency is central to credibility (Decrop, 2004). Transferability refers to the applicability of the research to other individuals, settings or situations (Decrop, 2004). This thesis increased its transferability by comparing the results to the literature (Decrop, 2004). Dependability indicates how reflective the collected data are of what transpired (Decrop, 2004); all interviews were recorded and the responses to the open-ended questions were saved so that researchers could review the original source material. Lastly, confirmability refers to the objectivity of the researcher (Decrop, 2004). In this research, intercoder reliability was calculated to confirm the replicability of the qualitative results (Krippendorff, 2012). Krippendorff's α was also calculated (Krippendorff, 2012) (Appendix H).

3.4.1.5. Story Survey recruitment and participants

Story Survey sampling procedure. Convenience sampling was used as a cost-effective method of increasing responses (Marshall, 1996). Links to the online survey were publicly posted and shared on FacebookTM and TwitterTM (Appendix I). These platforms allowed for a snowball sampling technique (Noy, 2008) where people reached by the researchers' initial posts could share or retweet the research invitation to people within their own networks. The sampling procedure introduced a bias towards younger, highly educated individuals who reported high levels of concern for climate change. However, being young and highly educated are characteristics associated with early adopters (Rogers, 2010) and pro-environmental attitudes are associated with early adopters of low carbon mobility (Carley et al., 2013; Plötz et al., 2014; Shaheen, Zhang, Martin, & Guzman, 2011). Therefore, the first phase of the research targeted a cohort of participants that would be expected to be more receptive to the ideas presented in the interventions due to their similarities to low carbon adopters. It was planned that later phases of the research could focus on broader or different populations.

Recruitment of the Story Survey targeted young adults aged 18-35 who would be 52-68 in 2050 and would likely expect to still be travelling at this time; people over the age of 35 were not excluded from the study. Recruitment notices were placed to attract younger adults who may be interested in travel. Online links to the survey were posted

on two backpacker forums (one international and one New Zealand specific). Physical flyers (Appendix I) containing the hyperlink and quick response (QR) code that linked directly to the survey were posted at four backpackers' hostels in Dunedin, a popular tourist town on the South Island of New Zealand.

It was thought that members of university and polytechnic tramping, travelling and cycling clubs would likely be interested and willing to participate in the research. An internet search of universities and polytechnics in New Zealand and England found 13 institutions which provided contact details for their tramping, travelling or cycling clubs. These clubs were sent an email request to participate in the research (Appendix I). New Zealand was selected as the interventions were set in New Zealand while England was targeted because it was also a small, English speaking island and there was existing literature available for comparison regarding the opinions of sustainable travel of the public in the U.K. (e.g. Hares, Dickinson & Wilkes; Miller, Rathouse, Scarles, Holmes, & Tribe, 2010). Therefore, there would be literature to help explain the results. Unfortunately, there were not enough respondents from the U.K. ($n = 9$) to create meaningful comparisons with the New Zealand respondents.

In order to increase the response rate, email invitations to participate were sent to all departments at the University of Otago (Dunedin, New Zealand), and two of the mailing lists associated with the researchers' department. Additionally, email invitations were also sent to an international post-graduate science communication mailing list, a Canadian science communication department, an Australian communication department and an Australian science communication mailing list in an attempt to expand the reach of the survey and increase the number of participants.

Data were collected through an internet-based survey hosted by SurveyGizmoTM which ran from February 24th to May 5th, 2016. The survey was in English but open to all nationalities. As an incentive to increase participation and completion, participants were offered the chance to enter a draw for an Amazon gift card valued at U.S. \$100 if they completed the survey. Following the survey, a winner was selected using a random number generator and the gift card was emailed to the winner. The research was approved by New Zealand University of Otago's Human Research ethics committee (Ref: D15/393, Appendix J) and all participants gave informed consent (Appendix K) before proceeding into the survey (Appendix A and F).

Story Survey sample population. A total of 401 useable responses were collected (See Section 3.4.2.1. for information on data cleaning). As expected, participants reported a high level of climate change concern. The majority 66% (n = 263) stated that they were ‘very concerned about climate change’ and 29% (n = 117) said that they were ‘somewhat concerned’. This is higher than the proportion reported by the Pew Research Center (2015). Another 4% (n = 15) reported that they were ‘not too concerned’. Only 2% (n = 7) stated that they were ‘not at all concerned about climate change’. New Zealanders were the most represented (39%) nationality within this study, followed by Australians (13%), Canadians (12%) and Americans (10%) (Figure 3.3a). Of the 395 respondents who provided their age, 61% were within the target age group of 18-35 (Figure 3.3b). The majority (68%) of participants in the study were female (Figure 3.3c). While not reflective of the global gender balance (World Bank, 2016), these results are similar to an American study investigating response bias in college students which found females to be two times more likely to respond to surveys than males (Sax, Gilmartin, & Bryant, 2003). This may be important as females tend to be more concerned about issues (including climate change) than males (McCright, 2010). Participants also tended to be highly educated, with 95% having a tertiary education and 55% having obtained some type of postgraduate qualification (Figure 3.3d).

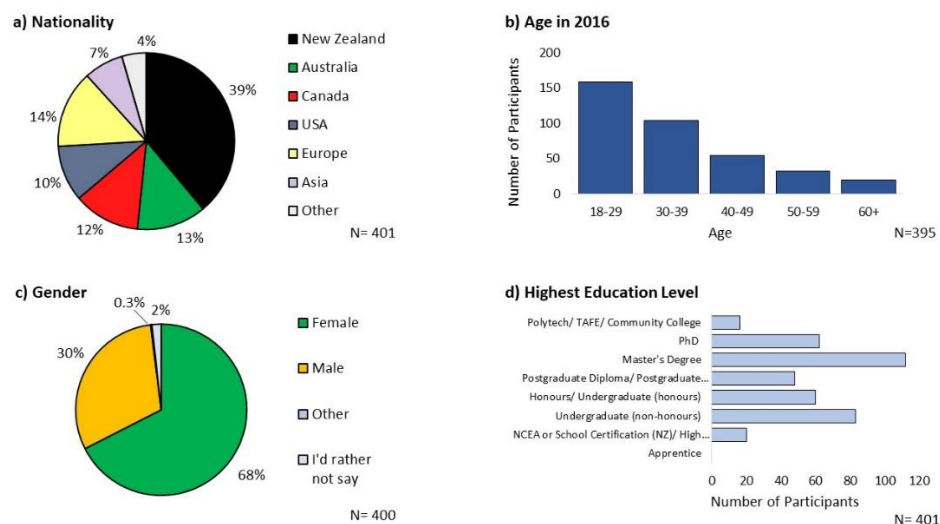


Figure 3.3: Nationality (a), age (b), gender (c) and education level (d) of respondents to the Story Survey

3.4.1.6. Temporal Distance Survey recruitment and participants

Temporal Distance Survey sampling procedure. The sampling procedure for the Story Survey resulted in a population representing an *interested public* instead of *general public* (Burns et al., 2003). A different sampling approach was taken in the Temporal Distance Survey in order to capture the opinions of a broader population more representative of a general public. Instead of relying on convenience sampling, a third party was hired to recruit participants. Ideally, the research would have targeted New Zealanders as they made up the largest population of participants in the Story Survey; however, the expense of conducting professional representative research in New Zealand exceeded the budget of this project. In the end, the United States was the only country where a company could be hired to collect 1000 responses affordably. Participants in the Temporal Distance Survey were recruited by the market research service SurveyMonkey™. To be eligible, participants needed to be at least 18 years old and living in the United States. The online survey was hosted by SurveyMonkey™ and ran 19 - 20 October, 2016.

Temporal Distance Survey sample population. A total of 1143 people completed the survey with 1071 useable responses (See Section 3.4.2.1. for details regarding data cleaning). As expected, participants in the Temporal Distance Survey were relatively representative of the American population in terms of age, gender and levels of concern regarding climate change. Ethnicity and income were not reported. Of the 1071 respondents, 52% (n = 557) identified as female, 46% (n = 491) identified as male and the remaining 2% identified as other (n = 8), preferred not to say (n = 9) or did not answer the questions (n = 6) (Figure 3.4a). The age of participants was fairly evenly distributed (Figure 3.4b). Participants aged 60 and over made up the largest age group (25%) while the least represented age group was between the ages of 40-49 (15%). Participants came from a wide variety of educational backgrounds (Figure 3.4c). An undergraduate degree was the highest qualification obtained by 27% of respondents. High school diplomas (20%), community college/technical college degrees (19%,) and master's degrees (18%) were also common.

With respect to how representative participants in the Temporal Distance Survey were compared to the general American population, the age and gender distribution of participants in the study were similar to those reported in the 2010 US Census (United States Census Bureau, 2011). The proportion of male and females in our study was

representative of the national data; however, 40-49 year olds were slightly underrepresented (15% compared to 19%), while 50-59 were slightly overrepresented (22% compared to 19%). Participants in our study also tended to have attained higher levels of education than those reported in a 2016 report by the US Census Bureau (Figure 3.4d).

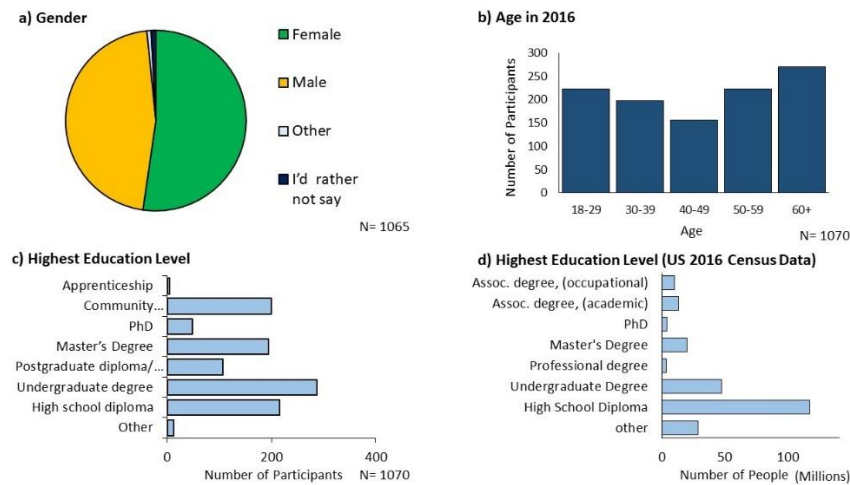


Figure 3.4: Demographics by gender (a), age (b) and highest level of education (c) of respondents to the Temporal Distance Survey and highest level of education data from the 2016 US Census (d).

3.4.1.7. Interview recruitment and participants

Interview sampling procedure. The purpose of conducting follow-up interviews with participants of the Story Survey was to explore the longer-term impacts of the story and textbook interventions (Appendix L). To do this, participants were asked if they would be willing to participate in a follow-up interview (Appendix A). Those who agreed voluntarily provided an email address that could be used to contact them. One hundred and ninety-nine of the 401 participants stated they would be interested in being interviewed. In July of 2017, an email was sent to all 199 participants who indicated interest in being interviewed, asking if they were still willing to participate in a follow-up interview. All participants who responded to this email and were available in August were interviewed. This led to 31 interviews being conducted throughout August 2017. Due to the international nature of participants, interviews were conducted over Skype, Zoom, the telephone, or in person depending on participant preference.

Interview sampling population. The interviewees are relatively representative of the survey participants (Table 3.7). Ten of the 31 individuals interviewed had read the story intervention while the remaining 21 interviewees had read the textbook intervention. As in the Story Survey, the greatest number of participants came from New Zealand (35%), followed by Australia (26%) and Canada (10%). There was at least one interviewee from each nationality category. Similarly, there were at least two interviewees from each age group with the largest cohort of interviewees between the ages of 18-29 (13%) and 30-39 (9%). The gender split was almost identical to that of the Story Survey (30% male, 70% female).

Table 3.7: Interviewees' nationally, gender, age, highest level of education and intervention.

Nationality	Intervention	Gender	Age	Highest Level of Education
New Zealander	Story	Female	18-29	Honours/ Undergraduate (honours)
New Zealander	Story	Female	18-29	Undergraduate (non-honours)
New Zealander	Story	Female	50-59	Postgraduate Diploma/ Postgraduate Certificate
New Zealander	Story	Male	30-39	Undergraduate (non-honours)
New Zealander	Story	Male	30-39	Master's Degree
New Zealander	Story	Male	40-49	Polytech/ TAFE/ Community College
New Zealander	Story	Male		Master's Degree
New Zealander	Textbook	Female	18-29	Postgraduate Diploma/ Postgraduate Certificate
New Zealander	Textbook	Female	18-29	Postgraduate Diploma/ Postgraduate Certificate
New Zealander	Textbook	Female	18-29	Undergraduate (non-honours)
New Zealander	Textbook	Male	30-39	Postgraduate Diploma/ Postgraduate Certificate
Australian	Story	Female	40-49	Postgraduate Diploma/ Postgraduate Certificate
Australian	Story	Male	40-49	Master's Degree
Australian	Textbook	Female	20-29	Master's Degree
Australian	Textbook	Female	30-39	Master's Degree
Australian	Textbook	Female	30-39	Master's Degree
Australian	Textbook	Female	30-39	Undergraduate (non-honours)
Australian	Textbook	Female	50-59	Undergraduate (non-honours)
Australian	Textbook	Female	60+	PhD
Canadian	Textbook	Female	25-29	PhD
Canadian	Textbook	Female	25-29	Undergraduate (non-honours)
Canadian	Textbook	Male	60+	NCEA or School Certification (NZ)/ High School Diploma
German	Textbook	Female	30-39	Undergraduate (non-honours)
German	Textbook	Female	50-59	PhD
German	Textbook	Male	20-29	Postgraduate Diploma/ Postgraduate Certificate
Brazilian	Story	Female	30-39	Master's Degree
Brazilian	Textbook	Male	20-29	Master's Degree
American	Story	Female	20-29	Honours/ Undergraduate (honours)
Finish	Textbook	Female	30-39	Honours/ Undergraduate (honours)
Italian	Textbook	Female	20-29	Master's Degree
Japanese	Textbook	Female	20-29	Master's Degree

3.4.2. Data analysis

3.4.2.1. Data cleaning

The process of data cleaning improves the quality of data by removing errors and inconsistencies (Rahm & Do, 2000; Van den Broeck, Cunningham, Eeckels, & Herbst, 2005). It is important for a study to identify how the data has been cleaned to minimize accusations of data manipulation (Van den Broeck et al., 2005). In this thesis, there were a few reasons that an entire survey response could have been excluded from the research. Surveys that were only partially completed were excluded from the research thesis as it was assumed that early termination was a withdrawal of consent. Therefore, it would have breached ethics approval to use the data from these surveys. Similarly, there were two participants in the Story Survey who did not agree to the consent form and so no data were collected from them. Temporal Distance Surveys were excluded from the research if participants did not answer question nine which investigated attitudes towards optimism, technology and environmental beliefs. This was because this question was important for determining the importance of temporal distance. This brought the total number of completed Temporal Distance Surveys from 1143 to 1071. Since question nine was composed of eight statements and these statements were analysed separately, a participant who only missed answering one of the eight statements was still included in the research.

With respect to cleaning up the data in specific questions, in the Temporal Distance Survey 43 respondents listed their education level as ‘other’ and then wrote in a specific answer. After closer inspection, it was determined that 31 of these 43 responses could be placed into existing categories. Participants were excluded from the before and after intervention comparisons if they did not provide a description of travel in the year 2050 following reading the intervention. Similarly, participants were excluded if they answered the questions with statements such as “same as before” or “already answered” as it is possible that they did not accurately remember what they initially wrote. In both the Story Survey and the Distance Survey, participants ranked global threats with one being the threat they were most concerned about and seven being the threat they were least concerned about. Not all participants ranked all seven threats. It was assumed that that unranked global threats represented a lack of concern. In an attempt to capture this lack of concern without skewing the rankings, during the analysis these values were flipped so that the threat that was most concerning was given a value of seven and the least concerning threat was given a value of one.

There were also a few ways in which the qualitative data were cleaned. The spelling and grammar were fixed when reporting answers to questions that participants had typed in. For example:

Well be driving electric cars Anna most if not all will be self driven. There may ever b flying cars and jet packs. We'll probably be traveling by hyperloop and supersonic jets. And probably a lot More public transit.

Became:

[We'll] be driving electric cars [and] most if not all will be self-driven. There may [even be] flying cars and jetpacks. We'll probably be traveling by hyperloop and supersonic jets. And probably a lot [more] public transit.

Similarly, when reporting quotes from the interviews superfluous words and sounds such as 'um' or 'ya' were deleted. For example:

...it might look like. **Um** having said that, you know my area of research has been in environmental impacts and that sort of thing so it's something that on an almost daily bases I am thinking about to some degree. But what I like about that and what I remember most about that is just that, **ya**, I hadn't...

Became:

...it might look like. Having said that, you know my area of research has been in environmental impacts and that sort of thing so it's something that on an almost daily bases I am thinking about to some degree. But what I like about that and what I remember most about that is just that, I hadn't...

3.4.2.2. Quantitative data analysis

A few different methods were used for quantitative data analysis. First, descriptive statistics were employed to gain a basic understanding of the characteristics of the data (O'Learly, 2010; Pallant, 2016). This was done using SPSSTM version 24. Once basic trends were identified the next step was to determine whether the data were normally distributed as the normality of data influences which tests are most appropriate for determining correlations and comparisons between groups (Pallant, 2016). Since the survey populations were less than 2000 a Shapiro Wilk test was used to assess normality (Pallant, 2016). As the data from the Story Survey and Temporal Distance Survey were not normally distributed, non-parametric tests were used to analyse the quantitative data. In both the Story Survey and Temporal Distance Survey, relationships between variables were identified through Spearman's correlations (O'Learly, 2010; Pallant, 2016). The

only exceptions to this were correlations involving non-binary nominal data (eg, education, gender). In these cases, a categorical regression was used.

In the Story Survey, it was important to compare the influence that the different interventions had. Wilcoxon signed-rank tests are a non-parametric test that identifies changes in a group over multiple time points (O'Learly, 2010; Pallant, 2016). Wilcoxon signed-rank tests were used in this thesis to compare changes in participants' answers before and after reading the interventions. The Story Survey also investigated the impact of the type of intervention participants were exposed too. Mann-Whitney tests are a non-parametric test to compare two different groups (O'Learly, 2010; Pallant, 2016), and so Mann-Whitney tests were used to compare answers between participants in the story intervention and the textbook intervention.

3.4.2.3. Qualitative data analysis

Qualitative data were analysed using thematic and content analysis. Thematic coding is a qualitative research method that identifies key concepts or 'themes' (Braun & Clarke, 2006) and content analysis allows others to replicate these themes (Krippendorff, 2012). Unlike codes which are descriptive terms that summarise the data, themes highlight the subtle processes being investigated (Saldaña, 2015). Coding manuals (Appendix M - P) were developed and were used in three to twelve iterative rounds of coding between the researcher, one supervisor and a third member of the research group. Each time a sample of 20 - 40 (5 - 10% of the data) responses was coded followed by a series of robust discussions where codes were merged, dropped, added, or refined until the researchers agreed upon overarching themes (Chapters Four, Five and Six) (Saldaña, 2015). Inter-coder reliability was calculated and percent agreement between the three researchers ranged from 86.7% - 100% (Appendix H). Krippendorff's α was also calculated with the lowest score being 0.723. The high level of agreement between the researchers supports our assertion that the analysis of the data is reliable (Krippendorff, 2012).

3.5. Limitations

As mentioned in Section 3.4.1.5., the sampling procedures used to recruit participants for the Story Survey introduced a bias towards younger, highly educated individuals who reported high levels of concern about climate change. However, this presented an opportunity to explore a cohort that was expected to be receptive to the idea

of a low carbon future. In an attempt to get a more representative cohort in the Temporal Distance Survey, the market research company SurveyMonkeyTM was commissioned to recruit participants. Although the company was able to recruit a broader range of respondents, the sample pool was limited to individuals living in the United States who belonged to SurveyMonkeyTM database. Using SurveyMonkeyTM to host the Temporal Distance Survey also meant that emails could not be collected from the participants, eliminating any chance of following up with respondents.

It was also difficult to create comparative texts of different styles for the Story Survey. A deliberate effort was made to include the same information in both texts (Table 3.3; however, due to the natures of the two styles, the texts were different lengths (Appendix B and C). Additionally, the way the information was described differed between the two texts. It is possible that any differences in responses between participants in the two intervention groups could be a result of an unintentional stylistic difference (see the discussion on causality in Section 6.2.1.1.).

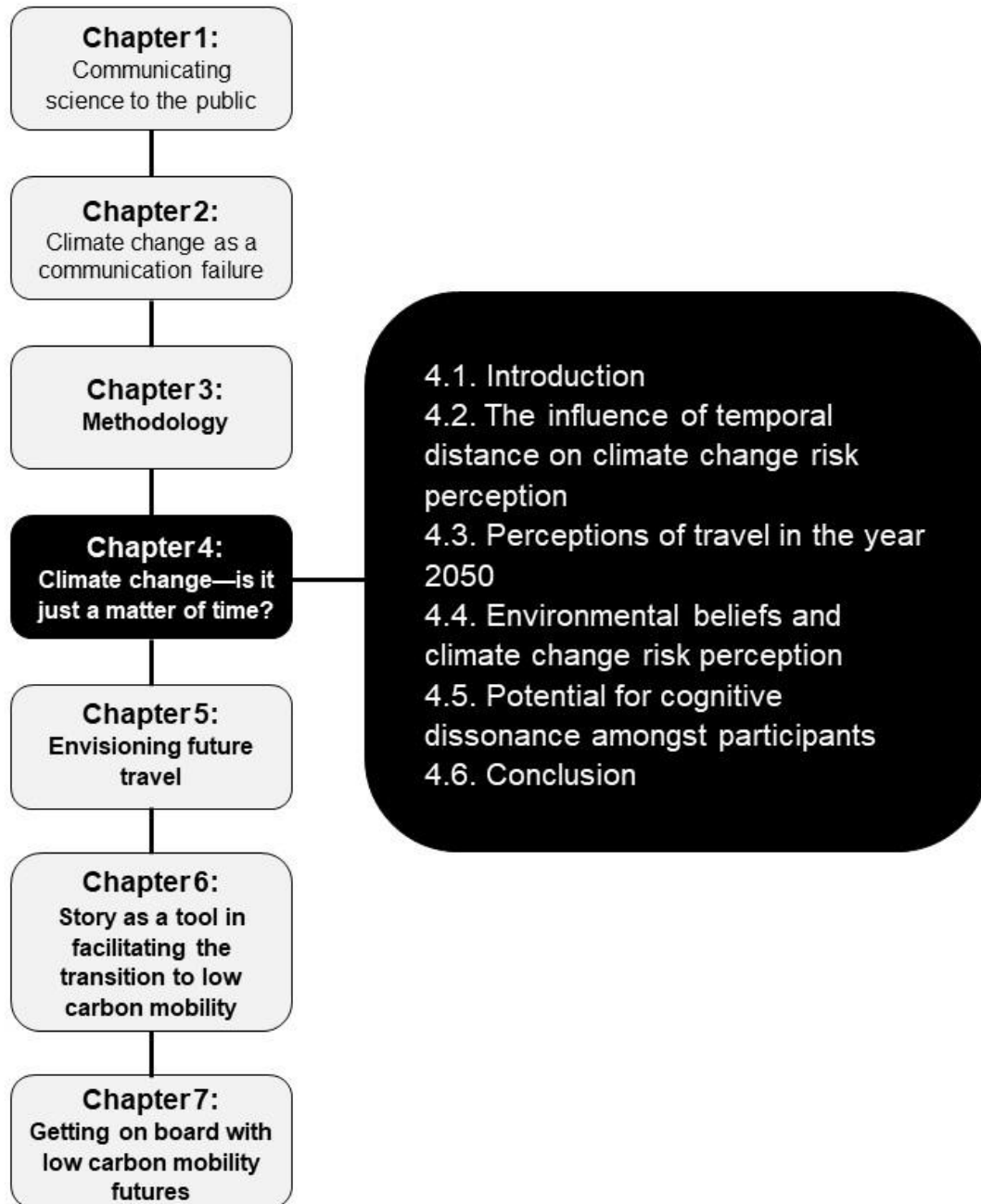
3.6. Conclusion

This research thesis approaches knowledge as being layered and having both objective and subjective components. More importantly, the research is concerned with the implications of participants holding certain beliefs. Thus, a pragmatic, mixed methods approach was used to address the five research questions set out in the previous chapter. The research was conducted in three phases with both quantitative and qualitative data being collected. The first two phases of the research involved the creation and distribution of two online surveys. These surveys targeted two different populations; the Story Survey targeted an interested public consisting of an international population reporting high levels of concern about climate change and the Temporal Distance Survey targeted an American general public. The final phase of the research involved follow-up interviews with 31 participants from the Story Survey to explore longer-term impacts of the story and textbook interventions. Survey and interview data were analysed using a combination of descriptive statistics, nonparametric statistics and thematic coding analysis.

Having established how the research in this thesis was conducted the next three chapters discuss the research findings. This begins with Chapter Four exploring the impact of temporal distance on climate change risk perceptions by investigating the

relationship between American participants' attitudes regarding the distant future and their expectations of travel in the year 2050.

Chapter 4: Climate change—is it just a matter of time?



4.1. Introduction

Chapter Two proposed that individuals' climate change risk perceptions might be influenced by temporal distance. For the purpose of this thesis, temporal distance was measured through an individual's ability to visualise the distant future and their future optimism (Figure 4.1). It was argued that people may have difficulty assessing climate change risk because they find it difficult to visualise the distant future, they are predisposed to be optimistic about their own personal futures and they may place faith in the ability of future technology to mitigate climate change (among other reasons). This chapter begins by testing these assumptions using an online survey of 1071 American residents. The second part of the chapter focuses on the third and fourth research questions. These questions asked how future travel is perceived by participants, namely are expectations of travel in 2050 consistent with the notion of a low carbon mobility future and are individual expectations of travel in 2050 related to levels of climate change concern. The third part of this chapter explores the influence of environmental beliefs on climate change risk perceptions to see if they are better predictors than temporal distance.

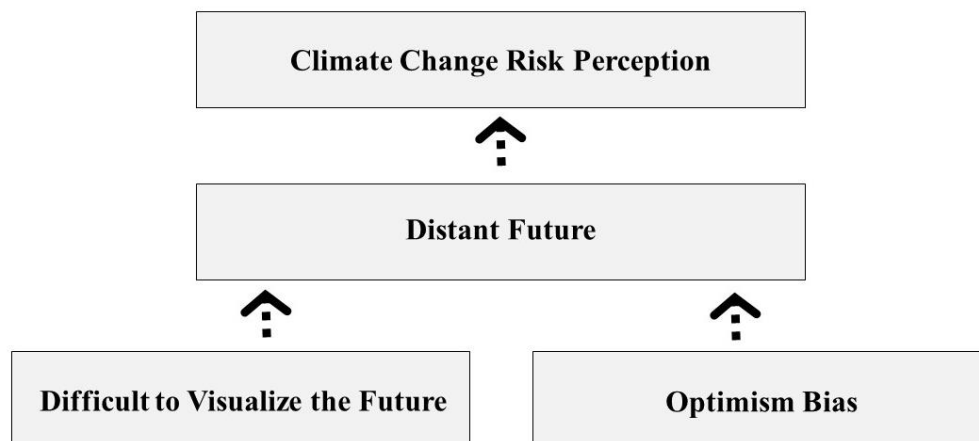


Figure 4.1: Temporal distance may affect climate change risk perception (influenced by: Howarth, 2017; Lorenzoni et al., 2007; Newby-Clark & Ross, 2003; Tonn et al., 2006; Trope & Liberman, 2003).

4.2. The influence of temporal distance on climate change risk perception

4.2.1. Ability to visualise the distant future

This thesis considered participants' self-reported ability to visualise the distant future as well as their future optimism when assessing the influence of temporal distance. It was thought that people who found it difficult to visualise the distant future may be less

concerned about climate change as the more severe consequences are often discussed as future events. Ability to visualise the distant future was estimated by asking participants how clearly they were able to visualise the year 2050. Of the 1067 respondents who answered the question, the majority (64%) said they had trouble visualising the year 2050, stating that it was either ‘not at all clear’ (21%, $n = 228$) or ‘not very’ clear (43%, $n = 460$). Thirty-two percent ($n = 340$) of participants said that it was ‘somewhat’ clear while only 4% ($n = 39$) said that they could very clearly visualise the year 2050. These results support the Tonn et al. (2006) findings that people have difficulty clearly visualising distant futures.

4.2.2. Future optimism

The second time-related factor explored in this thesis is optimism. Respondents tended to be optimistic about their personal futures (Figure 4.2) with less than one quarter

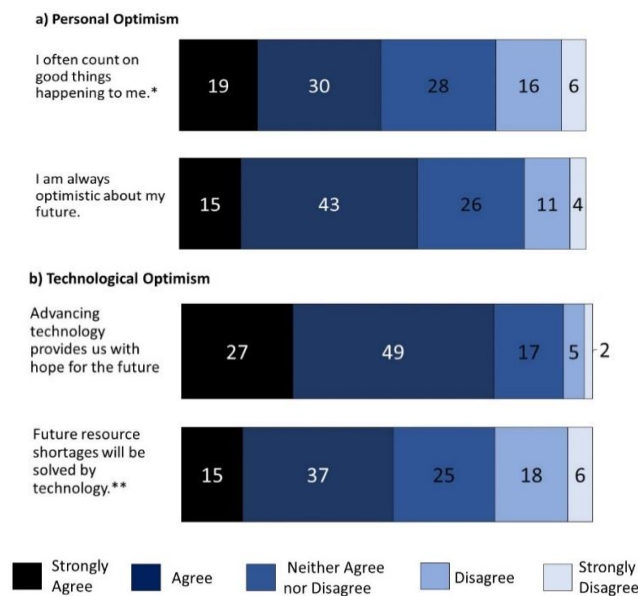


Figure 4.2: Percentage agreement on statements regarding participants' personal optimism (a) and technological optimism (b) ($N = 1068 - 1071$)

*original wording: I rarely count on good things happening to me.

** original wording: Future resource shortages will not be solved by technology.

of participants disagreeing with the statements *I often count on good things happening to me* and *I am always optimistic about my future* (Figure 4.2a). There was also a lot of optimism surrounding the role of technology (Figure 4.2b). In fact, 76% of participants either ‘agreed’ or ‘strongly agreed’ with the statement that *advancing technology*

provides us with hope for the future (Figure 4.2b). The majority of participants (52%) agreed that *future resource shortages will be solved by technology* (Figure 4.2b). Participants' high levels of optimism towards future technology could suggest that they may expect technology to play a major role in mitigating climate change.

4.2.3. Climate change risk perception

Most participants were concerned about climate change with 44% (n = 452) of respondents stating they were 'very concerned' and 30% (n = 312) saying they were 'somewhat concerned'. A total of 14% (n = 145) said they were 'not too concerned' and 9% (n = 88) were 'not at all concerned.' Only 4% of respondents (n = 40) said that they did not believe climate change exists. To explore how the perceived risk of climate change compared to the perceived risk of other global threats, participants were asked to rank their concern regarding AIDS, radioactive waste, loss of biodiversity, genetic modification, climate change, nuclear power and terrorism. Overall, climate change was ranked as the second most concerning issue behind terrorism by these American respondents (Table 4.1). This suggests participants perceived climate change to present a serious risk. Unsurprisingly, people who were more concerned about climate change were more likely to rank climate change as a top threat ($r(1004) = 0.727, p < 0.001$) and less likely to rank terrorism as a top threat ($r(1015) = -0.397, p < 0.001$).

Table 4.1: Seven global threats ranked by level of concern, with higher rank indicating greater concern.

Global Threat	Overall Rank	Mean Rank	N
Terrorism	1	5.2	1020
Climate Change	2	4.8	1007
Loss of biodiversity	3	4.1	999
Radioactive waste	4	4.0	997
Nuclear power	5	3.9	1004
Genetic modification	6	3.5	996
AIDS	7	2.6	997

4.2.4. Relating temporal distance to climate change risk perception

This study set out to investigate how temporal distance might influence Americans' ability to judge climate change risk. Participants' ability to visualise the distant future (the year 2050) was the first component of temporal distance that was considered. A Spearman's correlation revealed that participants' self-reported ability to

visualise the year 2050 was not related to their levels of concern about climate change ($p = 0.115$). The second component of temporal distance under consideration was future optimism. Participants' attitudes towards their personal optimism and technological optimism were combined to give a Total Optimism Score. A Spearman's correlations showed that participants' Total Optimism was not related to their levels of concern about climate change ($p = 0.162$). In fact, the only statement measuring optimism that was significantly correlated to participants' levels of climate change concern was *advancing technology provides us with hope for the future* ($r(10355) = 0.123$, $p < 0.001$). Since neither participants' ability to visualise the distant future nor their future optimism were correlated to their levels of concern about climate change the answer to the first research questions is that temporal distance (at least in terms of perceived ability to visualise the distant future and future optimism) is not a significant influencer of climate change risk perception. Thus, it would appear that the initial model (Figure 4.1) is not a good fit for explaining climate change risk perceptions.

4.3. Perceptions of travel in the year 2050

The third research question asked whether participants' expectations of travel in the year 2050 are consistent with the notion of a low carbon mobility future. When asked if travel would be different in 2050, there was an overwhelming agreement (87%, $n = 926$) amongst participants that travel will be different. Only 6% ($n = 64$) of participants suggested that travel will remain the same. The remaining 7% ($n = 79$) stated that they did not know if travel would change. Participants who said they thought that travel would change or who said they did not know if travel would change were asked to describe how they envisioned travel in the year 2050. The three most common predictions for how travel would differ were that it would: i) use new forms of travel technology, ii) be faster, and iii) be more environmentally sustainable (Table 4.2 see Appendix M for coding details).

Table 4.2. Percentage category frequency of participants' expectations regarding travel in the year 2050 (N=1005)

Theme	n	Percent
Future travel will use new forms of travel technology	462	46
Future travel will be faster	318	32
Future travel will be more environmentally sustainable	279	28

Only 28% (n = 279) of participants described travel in the year 2050 as becoming more environmentally sustainable (Table 4.2). This suggests that with respect to the third research question, expectations of future travel do not tend to reflect a low carbon future. There were three ways that participants envisioned future travel becoming more sustainable (Table 4.3 see Appendix M for coding details). The first method is through changes in transport behaviour including an increased reliance on mass transit including more public transport and rail, less individual and more communal ownership of cars, less flying and more local travel.

California will have a bullet train aka high speed railroad from San Francisco to Los Angeles thus reducing need for intra-state air flights. Car manufacturers like Tesla pushing self driving car technology onto the market will redefine/shift luxury car market from cars w/leather seats to cars able to drive themselves, thus also increasing public transportation buses since cities no longer limited to finding certified commercial drivers [Male, 30-39].

The second method was a decrease in fossil fuel use (Table 4.3). Often this was due to a shift towards electric, solar, hydrogen or hybrid vehicles. For example, “I think all cars will be electric, or some other environmentally friendly form of fuel [Female, 50-59].” Lastly, 4% of participants made general references to future travel becoming more eco-friendly.

Table 4.3. Percentage category frequency of participants’ expectations regarding environmentally sustainable travel in the year 2050 (N=1005)

Theme	Sub-theme	n	Percent
Future travel will be more environmentally sustainable	Change in transport behaviour	152	15
	Use less fossil fuels	128	13
	Becoming more eco-friendly	38	4

Consistent with participants’ general optimism about technology, the most common expectation of travel in the year 2050 was that it would involve new technology. Participants described a wide variety of new types of technology that they said would exist or be readily utilised by 2050 including virtual travel, commercial space travel, hover cars, smart cars, electric vehicles and a network of underground vacuum tubes (see Appendix M for coding details). The most frequently mentioned form of new travel technology was autonomous or self-driving vehicles with 19% (n = 186) of participants

discussing them. One participant explained, “I tell my vehicle where I want to go, it takes me there without intervention on my part [Female, 60+].” Other examples of suggestions of future travel included, “Near orbital planes, self-driving cars, maglev trains, space travel (hopefully) [Male, 18-29]” and “We will have teleportation for those able to afford it/access it. Otherwise, it will be controlled by google, public transportation robot vehicles [Male, 30-39].”

Compared to expectations regarding transitioning to more environmentally sustainable travel, the expectation that travel will become faster was also more prevalent in respondents’ depictions of year 2050 (Table 4.2). For example, one participant described travel in 2050 as having “More high speed trains, international flights that are faster because they are supersonic [Male, 50-59].” Similarly, another respondent wrote “I think there will be the same type of options that we have now, just more efficient & faster [Female, 60+].”

While faster travel and new technologies are not *necessarily* incompatible with a low carbon future (see Chapter Five for discussion), the fact that these expectations were more common suggests that either participants do not associate future travel with low carbon mobility or that it is not their highest priority. The fourth research question investigated whether participants’ expectations of travel in 2050 were related to their levels of concern about climate change. A Spearman’s correlation found participants’ levels of concern about climate change concern were weakly correlated to whether they discussed future travel as becoming more sustainable ($r(1036) = 0.156, p < 0.001$) with people who were more concerned about climate change being more likely to describe future travel as being more environmental sustainable in 2050. Therefore, to answer the fourth research questions, it appears that levels of concern about climate change are weakly correlated to the likelihood of participants mentioning modes of low carbon mobility when describing future travel.

4.4. Environmental beliefs and climate change risk perception

Climate change poses a serious threat to the environment (IPCC, 2014). This may explain why participants who reported higher levels of concern about climate change were also more likely to rank loss of biodiversity as a greater threat ($r(994) = 0.126, p < 0.001$). Participants reported low levels of environmental concern with only 29% agreeing that *there are limits to growth beyond which our industrialised society cannot expand* and

disagreeing that *humans have the right to modify the natural environment to suit their needs* (n = 309 and n = 304) (Figure 4.3). There was also an overwhelming feeling amongst participants in this American survey that business interests have more political power than individuals with three quarters either ‘agreeing’ or ‘strongly agreeing’ with this statement (Figure 4.3).

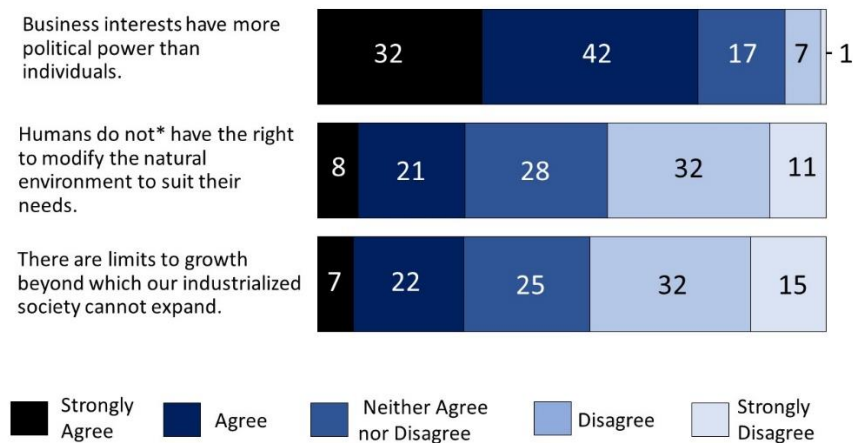


Figure 4.3: Percentage agreement with statements regarding participants’ environmental beliefs (N = 1068 – 1071)

*original wording: Humans have the right to modify the natural environment to suit their needs

There was a moderate, negative correlation between participants’ agreement that humans have the *right to modify the natural environment to suit their needs* and their levels of concern about climate change ($r(1033) = -0.307$, $p < 0.001$). This means that participants who reported higher levels of concern about climate change were less likely to agree that humans have *the right to modify the natural environment to suit their needs*. There was a also weak, positive correlation between climate change concern and agreement that *business interests have more political power than individuals* ($r(1037) = 0.104$, $p = 0.001$). This means that participants who reported higher levels of concern about climate change were more likely to agree that *business interests have more political power than individuals*. When comparing participants’ attitudes towards unlimited industrialised growth and their levels of climate change concern a Spearman’s correlation identified the relationship as significant ($n = 1037$, $p = 0.021$); however, since the effect size was less than 0.1 ($r(1037) = -0.072$) it is likely a false positive meaning that the two

variables are unlikely to be related. Overall, environmental beliefs appear to be related to levels of concern about climate change. As such their environmental beliefs may be better predictors of climate change risk perceptions than temporal distance as discussed below.

4.5. Potential for cognitive dissonance amongst participants

The previous section found environmental beliefs to be a better predictor of levels of concern about climate change than temporal distance. However, the results also showed that participants' attitudes towards technology have an interesting relationship with both environmental beliefs and climate change risk perception. This complicated relationship could lead to *cognitive dissonance*. Cognitive dissonance occurs when an individual obtains new information (in the form of knowledge, feelings, behaviours) that is internally inconsistent with existing views (Festinger, 1962). Individuals can minimise cognitive dissonance by ignoring the new information or changing their existing information (Festinger, 1962).

On the one hand, the idea that *advancing technology provides us with hope for the future* was positively correlated to the idea of unlimited industrialised growth ($r(1068) = 0.126, p < 0.001$). Participants who were more optimistic about advancing technology may have been more likely to believe in unlimited growth because technology has been a major reason why society has yet to hit the limit to growth due to resource shortages that was predicted in the 1970s (Eastin et al., 2011). Unsurprisingly, the idea of unlimited growth was also positively correlated with the idea that future resource shortages will be solved by technology ($r(1069) = 0.318, p < 0.001$). Since resource shortage is an expected outcome of climate change (IPCC, 2014), it is possible that participants who thought technology will solve future resource shortages might have been less concerned about climate change as they would have believed these shortages could be overcome. However, there was no correlation between participants' attitudes towards these two statements ($p = 0.912$).

On the other hand, participants who were more concerned about climate change were also more likely to agree that future technology provides hope for the future (Section 4.2.4.). This could be because participants who are more concerned about climate change may perceive technology as the best or most likely way to mitigate climate change. At the same time, participants who reported higher levels of climate change concern also tended to disagree that humans have the right to modify the natural environment to suit

their needs. This poses an interesting question regarding what types of climate mitigating technologies may or may not be acceptable. For example, the presence of high speed train systems across the United States was frequently mentioned by participants in the study as a way that travel would change by the year 2050 (Section 4.3). Although high speed trains have the potential to make future travel more sustainable they would require a lot of new infrastructure, raising questions around the acceptability of disrupting natural ecosystems in order to create systems that could help reduce carbon emission.

A more extreme solution would be geoengineering. A workshop looking at public perceptions of geoengineering in the U.K. found participants tended to view geoengineering as interfering with nature but were divided as to whether geoengineering was a harmful or necessary mitigation strategy (Corner et al., 2013). The acceptability of geoengineering as a method of climate change mitigation may be dependent on personal values (Braman, Kahan, Jenkins-Smith, Tarantola, & Silva, 2012). Results from the 2011 National Survey of American Public Opinion on Climate Change (NSAPOCC) found that Americans who believed in climate change were more likely to agree that humans can use geoengineering to combat climate change, whereas those who did not believe in climate change were more likely to agree that geoengineering will do more harm than good (Borick & Rabe, 2012). Perhaps those who are more concerned about climate change reduce *cognitive dissonance* by justifying geoengineering as an acceptable or necessary modification of nature.

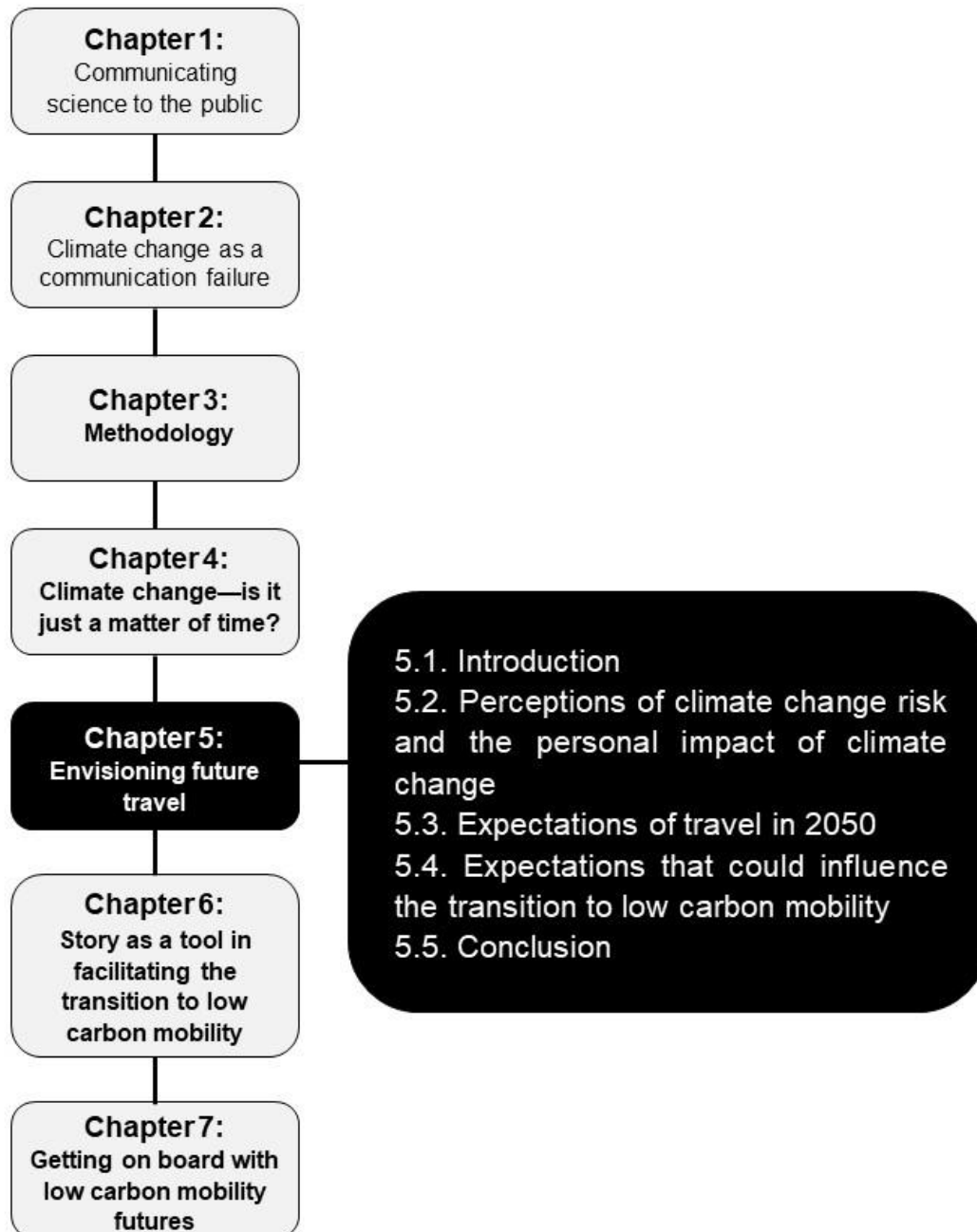
It would seem that, despite the fact that environmental beliefs were found to be related to participants' climate change risk perceptions, there is the potential for climate change mitigation initiatives to conflict with other (in this case environmental) beliefs. This could produce cognitive dissonance. Scruggs and Benegal (2012) used cognitive dissonance to explain why there was a noticeable decrease in climate change concern during the late 2000s. They suggested that following the 2008 global financial crisis when faced with conflicting feelings towards stimulating the economy and mitigating climate change, people tended to adjust their levels of concern regarding climate change risk to reduce cognitive dissonance (Scruggs & Benegal, 2012). Based on this, perhaps cognitive dissonance could be a useful theoretical framework for future studies exploring climate change risk perception.

4.6. Conclusion

This chapter explored whether the distant nature of climate change influences individual's levels of climate change concern. Based on these results, it would seem that the distant nature of climate change is unlikely to be a major affecter of climate change risk perception. Only the statement *advancing technology provides hope for the future* was correlated to levels of climate change concern. Therefore, the original model suggesting temporal distance influences climate change risk perception was rejected. The results in this chapter also suggest that environmental beliefs may be better predictors of climate change risk perceptions, but that expectations surrounding future technology have the potential to create cognitive dissonance between an individuals' environmental beliefs and beliefs regarding strategies to mitigate climate change.

This chapter also found that very few participants described future travel as having become more environmentally sustainable. However, individual's expectations of low carbon mobility were correlated to their levels of climate change concern. The next chapter further investigates this relationship between climate change concern and expectations of future travel by surveying a cohort of individuals reporting high levels of concern about climate change.

Chapter 5: Envisioning future travel



5.1. Introduction

This chapter furthers investigate the relationship between an individual's level of concern about climate change and their description of future travel. Since the previous chapter found that expectations of low carbon mobility were related to levels of concern about climate change in an American population that was representative of a general public, this chapter focuses on a cohort of individuals' reporting high levels of concern about climate change. The third research question asking whether participants' expectations of future travel are consistent with the idea of a low carbon future is re-examined with this different, international cohort of younger, highly educated participants (N = 401) (See Section 3.4.1.5 for details regarding cohort demographics).

The chapter begins by reviewing participants' levels of climate change concern and their expectations of whether climate change may affect them in the future. Next, participants' expectations of travel in the year 2050 are discussed. The chapter also considers the fourth research question to see if expectations of low carbon mobility futures are correlated to levels of climate change concern in this population as well. The chapter concludes with a discussion of how some of the other expectations of future travel that participants hold could work to either hinder or facilitate the transition to low carbon mobility.

5.2. Perceptions of climate change risk and the personal impact of climate change

Sixty-six percent of participants stated they were 'very concerned about climate change' and an additional 28% said they were 'somewhat concerned about climate change' (Figure 5.1). Only 6% were either 'not too concerned' or 'not at all concerned about climate change.' When asked if they thought climate change would affect their lifestyle in the year 2050 72% (n = 289 of a total N = 400) agreed. Similarly, 76% (n = 305 of a total N = 399) agreed that climate change would affect their travel plans in the year 2050. This suggests that the majority of participants were concerned about climate change and aware of how climate change could personally affect them.

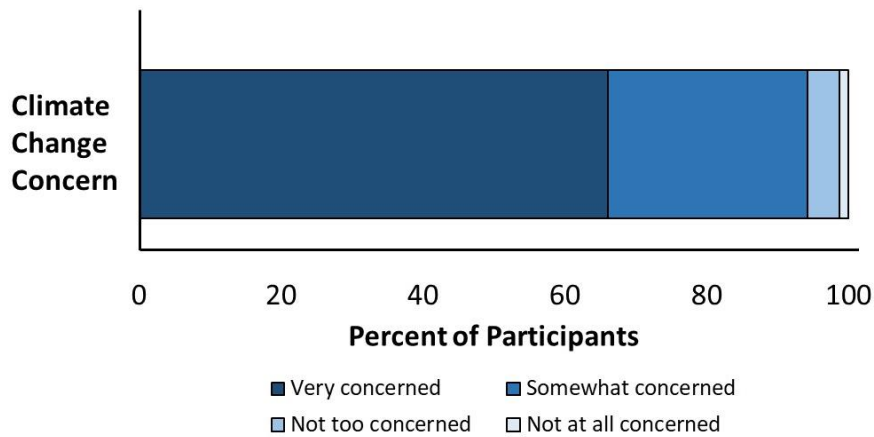


Figure 5.1: Participants' reported level of concern about climate change concern (N = 399)

5.3. Expectations of travel in 2050

Once again, this chapter examines whether participants' expectations of travel in the year 2050 aligned with the idea of a low carbon mobility future. Ninety-one percent (n = 365) of participants agreed that travel would be different in the year 2050. However, despite 66% of participants stating that they were very concerned about climate change (Figure 5.1), less than half (43%) described travel as having transitioned to low carbon mobility (Table 5.1.). Although this is higher than the 28% percent of participants than in the previous chapter, it is still less than half of all participants. This supports the previous finding that participants' depictions of future travel more often than not, do not contain references to low carbon mobility (Section 4.3). As in Section 4.2.4., participants who reported higher levels of climate change concern were significantly more likely to describe travel in the year 2050 as involving low carbon mobility ($r(399) = 0.114$, $p = 0.023$). This supports the previous findings regarding the fourth research question—expectations of future travel are related to levels of climate change concern.

Table 5.1: Percentage category of participants' expectations regarding carbon mobility systems in the year 2050 (N=401)

Theme	Frequency	Percent
Travel in 2050 will use low carbon mobility systems	174	43
Travel in 2050 will use high carbon mobility systems	91	23
Travel in 2050 will reinforce low carbon mobility systems	122	30
Travel in 2050 will reinforce high carbon mobility systems	222	55

Participants described low carbon mobility as using less fossil fuels through improved engines or switching to alternative fuels (Tables 5.2 see Appendix N for full coding details). For example, one participant suggested that in the year 2050 there would be “More public transportation due to increased population levels. Unless electronic cars are mass produced to reduce gas costs [Male, New Zealander, 18-29].” Participants also discussed changing transport behaviours through increasing the use of mass transport, less flying, and less car ownership (Tables 5.2.). For instance:

People will travel less. They will commute shorter distances and do so much less driving cars. They will also fly less due to cost. There will be an important shared transportation infrastructure. In general, the collective transportation structure will be much expanded and improved, but the travel experience will not necessarily be improved since a larger population means more use of that infrastructure. [Male, Swiss, 30-39]

There were also general references to travel becoming more environmentally sustainable (Table 5.2). For example, “Technology is always increasing and improving so [it is] likely [there will be] faster, cleaner means of transport [Female, French, 40-49].

Table 5.2: Low and high carbon travel used in 2050 as discussed by participants’ (N = 401)

Transport System	Theme	Frequency	Percent
Low carbon transport systems	Use less fossil fuels	116	29
	Change in transport behaviours	68	17
	Become more environmentally friendly	31	8
High carbon transport systems	Continued use of fossil fuels	91	23
	Increase in air travel	5	1

Participants were more likely to describe travel in 2050 as having transitioned to lower carbon mobility systems than they were to describe it as still utilising high carbon systems (Table 5.1), yet they were also more likely to mention expectations that would reinforce high carbon mobility than they were to mention expectations that would reinforce a transition to low carbon mobility (Table 5.1). Fifty-five percent of participants mentioned expectations that might reinforce high carbon transport systems (Table 5.1). Expectations that could reinforce high carbon transport systems included the notion that

by 2050 travel would be faster, include commercial space travel, and that travel itself would change (Table 5.3). The expectation that travel in 2050 will become “Faster and cheaper and more accessible [Female, New Zealander, 18-29],” and the statement “I am 100% confident that commercial space travel will be a reality by the year 2050 [Male, United Kingdom, 18-29]” are two examples of depictions in which future travel may still emit a large amount of carbon because high carbon systems has been reinforced (Table 5.3). The changes to travel that could reinforce high carbon mobility systems include travel becoming cheaper, travel becoming more convenient, individuals travelling further, an increased number of people travelling and/or people travelling more often.

I think that travelling in 2050 will be much simpler and more common. There will be increased availability and faster modes of transportation available, which will increase convenience and lower costs. I think it will be common place to go from Canada to Europe for vacations or even farther away, like Asia or the Middle East. [Female, Canadian, 18-29]

Slightly fewer (30%) participants discussed future travel in a way that could reinforce a shift towards lower carbon mobility systems (Table 5.1). Expectations that might reinforce low carbon transport systems included references to a decrease in travel (including travelling virtually instead of physically travelling places) and factors that could discourage travel such as increased expenses and restrictions.

I also wonder whether the number of people who can travel, where we will have the right to go or where we may no longer want to go will change. Wars, climate change, different combinations of visas and country agreements or disagreements might make currently "normal" destinations seem impossible to travel to. [Female, United Kingdom, 30-39]

Local travel was also considered to be a change in travel that could reinforce a transition to low carbon mobility. One participant explained that future travel would consist of “Less air travel, more local low energy mobility [Male, New Zealander, 60+].” Reference to other methods that could foster this transition such as returning to older forms of travel technology including walking or cycling or the notion that travel will become slower were uncommon (Table 5.3).

It will be either much harder and slower, or much easier and faster! If we have a crisis of conscience about carbon footprint and modes of travel don't change hugely, then we will walk or revert to bicycles and horses/donkeys. If modes of travel change, we could be teleporting around the globe, powered by burning calendula flowers. [Female, New Zealander, 50-59]

Table 5.3: Factors in participant responses that could reinforce low or high carbon travel used in 2050 (N = 401)

Transport System	Reinforcing Factors	Frequency	Percent
Low carbon transport systems	Changes in travel	111	28
	Return to older forms of travel	17	4
	technology Slower travel	5	1
High carbon transport systems	Faster travel	165	41
	Changes in travel	140	35
	Space Travel	33	8

Lastly, 23% of participants mentioned high carbon mobility systems such as continued use of cars and airplanes without suggesting any attempts to lower the carbon output of these systems (Table 5.1). This included responses such as the statement that future travel would become “Faster and more comfortable. Catching a plane will be like catching a bus [Female, New Zealander, 18-29].”

5.4. Expectations that could influence the transition to low carbon mobility

5.4.1. Speed

Since participants were more likely to mention expectations that reinforce high carbon mobility than those that would reinforce a transition to low carbon mobility, it would seem that even those concerned about climate change experience conflicting desires and expectations that will make it difficult to switch to low carbon transport. Consider participants’ expectations regarding the future of aeromobility. Very few participants suggested that there will be less flying in 2050 even though under existing technologies air travel conflicts with the idea of low carbon transport (Becken & Mackey, 2017). This could be because aeromobility is consistent with participants’ expectation regarding the increased speed of future travel (Table 5.3). Many participants perceived that future travel would become faster (a small number of respondents expressed their desire for travel to be instantaneous) while very few stated it would be slower (Table 5.3).

Travelling will be faster, easier and more convenient (e.g. things like Maglev which will be introduced in Japan in 10 years as a type of Shinkansen will be more popular?). Probably planes will become able to move faster. Cars will be more eco-friendly. But there will be no time machine or teleportation machine. [Female, Japanese, 18-29]

A common explanation for why people choose to fly is because it is faster than other mass transport such as trains (Hares et al., 2010; Miller et al., 2010). Participants appear to assume flying will continue being a common mode of transportation in the future based on their expectation that future travel will be faster and flying is the fastest form of travel currently available. One participant explained “Travel will still be done predominantly by air travel as it balances speed with the efficiency of high altitude. However, aircraft will be much more efficient [Male, New Zealander, 18-29].” It was also suggested that high speed rail would become more prevalent by 2050. There is a possibility that high speed train networks could make rail travel more appealing, but it is difficult to know whether they will be fast enough to compete with air travel.

The results also suggest that the ‘slow travel’ movement which has been explored as being a more climate friendly method of travel (Ceron & Dubois, 2007; Dickinson et al., 2011; Gössling, Hall, Lane & Weaver, 2008; Molz, 2009) is an unrealistic way to facilitate a transition towards a low carbon mobility system because the majority of people expect travel to be fast not slow. Perhaps a better avenue of transition would involve aligning low carbon alternatives such as public transport with participants’ expectations of speed. Structural changes including changes in government funding, policies and regulations should address infrastructure. For example, public transport users in Portugal stated that the presence of bus lanes on highways means that public transport can be faster than private vehicles (Beirão & Cabral, 2007). At an individual level, simply getting individuals to try public transport can positively influence their perceptions regarding its speed (Fujii, Gärling, & Kitamura, 2001). This may be an important step as individual practices (particularly habits) can facilitate public transport use (Bamberg, Ajzen, & Schmidt, 2003).

5.4.2. Cost

Cost may also promote the continuation of current high carbon mobility systems. The few participants who suggested that there would be less flying in the year 2050 often attributed this change to an increase in cost. One participant wrote, “I don't think there will be as much travel by plane because of the cost of fuel and environmental concerns [Female, Australian, 50-59].” The term ‘prohibitively expensive’ was used amongst respondents and reinforces the idea that cost can dictate people’s mode of transport. The relatively cheaper price of airplane tickets compared to train tickets in Europe has been

identified as an influencing factor as to why people choose air over rail travel (Barr, Shaw, Coles, & Prillwitz, 2010; Hares et. al., 2010; Miller et. al., 2010).

There were a number of participants who predicted that “flying will be much cheaper [Female, Japanese, 18-29]” in 2050. Participants’ expectations (or hopes) that airlines will continue to reduce their prices could lead to i) the continuation to travel by airplane, ii) an increased number of people flying because they can afford it, and/or iii) people flying more often. Since flying is a high carbon mode of transportation (Creutzig et al., 2015), scenarios that predict an increased number of flights are scenarios where high carbon mobility is perpetuated, once again suggesting that expectations of future travel may conflict with realistic transitions to low carbon mobility systems.

Governments could encourage people to engage in more sustainable travel through structural changes such as implementing policies that assess environmental damage and add it to the cost of the transport option (Steenberghen & Lopez, 2008; Sumner, Bird, & Dobos, 2011). However, cheaper options don’t necessarily take precedence as illustrated by the simple fact that most people are not cycling to work despite the fact that bicycles are significantly less expensive than cars. Additionally, encouraging people to adopt more sustainable methods of travel by taxing or increasing the cost of transport that uses fossil fuel could exacerbate inequity. A 2007 review of sustainable transport suggested that road taxes could unfairly punish poorer families who are less able to afford to pay the tax, yet may be more reliant on cars to complete daily errands such as dropping children off at school (Chapman, 2007). Governments need to be careful that policies meant to help transition people to low carbon transport mobility do not end up unfairly hurting people as these could cause resistance.

This idea of exacerbated inequality was mentioned by a small number of participants (n = 8) who alluded to the fact that if flying becomes more expensive in the future then only a select, privileged few will be able to continue to afford to fly while everyone else will either have to travel less or travel differently.

I think there will be two modes of travel. The very wealthy will have access to technology that permits fast and convenient reaching of any destination, including off planet and there will be bespoke activities for these to engage in. The remainder of the population will travel more locally and will travel less frequently because it will be too expensive. They will largely travel online and in virtual mode. [Female, German, 50-59]

Research on social tourism suggests that low income families benefit from having the opportunity to travel, so policies that use cost as a travel deterrent could have negative consequences (Minnaert, Maitland, & Miller, 2009). However, these reported benefits can be achieved with local holidays which would align with lower carbon mobility systems (Minnaert et al., 2009).

5.4.3. Convenience

Reducing fossil fuel consumption was the most common depiction of how travel in 2050 would have transitioned to low carbon mobility systems.

I imagine we will not be dependent on fossil fuels and will primarily use renewable or sustainable fuel sources. With this will come new technological advances such as better electric cars or even hydrogen cars and other better transportation vehicles. [Female, American, 30-39]

One reason increasing eco-efficiency may have been so popular amongst participants could be because it aligned with their expectations of convenience. Participants may perceive more fuel-efficient engines and alternative fuels as the least disruptive way to engage in more sustainable travel. An electric car allows a person to be more environmentally friendly without giving up the convenience of having their own vehicle, whereas public transport can be perceived as being inconvenient due to many factors including lack of infrastructure, problems with punctuality, and longer length of trips (Beirão & Cabral, 2007; Khalid, Bachok, Osman, & Ibrahim, 2014). Thus, convenience may be another important factor in dictating what types of mobility transitions people are willing to engage in.

Studies investigating how to get more people to cycle instead of drive have found that conveniences such as the presence of bike paths and bike lanes (Buehler & Pucher, 2012), traffic lights, intersections (route connectivity), lack of highway or hills and shorter distances increased the likelihood that people would cycle (Winters, Brauer, Setton & Teschke, 2010). If transitioning towards low carbon mobility conflicts with the expectation of increased convenience, then people may become conflicted about engaging in this transition. To address this, governments can create infrastructure to increase the convenience of low carbon mobility systems.

Transportation for international travel would be faster and more convenient. Moreover, the railway network will be improved [making it easier] to travel to other cities which are far away. [Female, Hong Kong, 18-29]

Improved infrastructure may also help reinforce social norms. While a 2013 review of the global literature on bike share programs found that people were unlikely to give up driving to start cycling (Fishman, Washington & Haworth, 2014), Harré (2011) suggests that observing other people cycle to work might lead to changes in individual travel behaviour through the processes of modelling and social norms. Therefore, bike share programs may help transition by making cycling more visible.

5.4.4. Technology

A common expectation from participants was that industry and technology would advance so that individuals could engage in lower carbon mobility without sacrificing their other expectations such as speed or convenience. For example, “I think it will be easier in terms of speed and comfort as technology develops and it will become more environmentally conscious [Female, New Zealander, 18-29]. There were predictions that travel would “faster and hopefully more fuel efficient [Female, American]”. Not only does this expectation assume that the required technology will have been invented but also that industry will adopt these technological changes into their common practices.

In terms of more environmentally sustainable air travel, some participants thought that there would be “Hydrogen powered airplanes [Male, American, 40-49]” or “that flight may use biofuels, or some technology that has yet to be invented [Male, New Zealander, 30-39].” However, Åkerman (2005) argues that while large scale design changes may be most effective at lowering GHG emissions within the aviation industries, they are less likely to be actualised by 2050 compared to smaller incremental improvements. Therefore, while participants may expect new technology to be able to help mitigate climate change this may be unrealistic. Unfortunately, even small gains in efficiency within the aviation industry are expected to be overshadowed by an increased number of people flying. This suggests that cultural constructs such as social norms may be more influential in reducing carbon usage within the aviation industry than technical changes (Gössling et al., 2007). Therefore, cultural change may be the most effective way to diverge from high carbon air travel.

Airplanes will be much the same design - after 100 years of flight the basic design of a plane hasn't changed and that won't occur in the next 50. Supersonic transport will be back in the industry, however with larger capacities than Concorde had. The primary driving factor for travellers will still be cost, and the products delivered will represent that - it will still be large capacity squashed in but at low cost. Technology will filter down to improve that experience, but people will still default to the cheapest

option and so change will be incremental, not revolutionary. Aeroplane technology around fuel and environmental impact will have likely made the biggest strides - clean fuel and lightweight composite planes to reduce the impact of travel. [Male, Australian, 30-39]

That being said, since individuals are reluctant to give up their flying habits (Miller et al. 2010), it may be unrealistic to expect social norms around flying to shift without outside pressure. Having government employ structural changes and implement policies that restrict air travel may be one way to make flying a less normalised mode of transportation. Yet governments may be reluctant to implement such unpopular policies. For example, people living in the U.K. were less likely to support government policies that they perceive to infringe upon their right to travel (Hares et al., 2010; Higham, Cohen, Cavaliere, Reis, & Finkler, 2016) and so the British government may be less willing to implement policies that restrict air travel to mitigate climate change. It is possible that this unwillingness to support policies that restrict travel stem from citizens' perceptions that flying is a right or entitlement (Miller et al. 2010). This complicates matters as it means that culture (in this case the culture where air travel is not considered reprehensible; Higham et al., 2018) is a significant propagator of high carbon air transport.

While not impossible for game-changing technologies to be invented and adopted by 2050, even this would likely require governmental support. Without governmental support, it can be difficult for inventors and entrepreneurs to develop and bring to market game-changing technologies. The American entrepreneur Elon Musk — famous for his electronic car company Tesla Motors, cell solar panel company SolarCity Corp. and space program Space Exploration Technologies Corp. (SpaceX) — received an estimated \$4.9 billion dollars in governmental support without which the companies would probably not exist (Hirsch, 2015). Again, this reinforces the idea that business alone is unlikely to facilitate the transition to low carbon mobility and that a multi-level, integrated approach is needed (Rotmans et al., 2001).

5.4.5. Commercial space travel

Lastly, the idea of commercial space travel was popular amongst participants. This included both references to space tourism and sub-orbital space travel as simply a means of faster transportation.

I imagine it will be much more environmentally friendly (hopefully!), and with reduced travelling times. I imagine by 2050 space tourism will also have taken off, and it will be more accessible for average people to travel to space (maybe the moon!) [Female, New Zealander, 18-29]

However, there are questions surrounding the possibility of transition to a lower carbon mobility system by the year 2050 while engaging in commercial space travel. Considerations as to whether commercial space travel is beneficial or harmful to sustainability include whether sustainability extends beyond earth (Spector, Higham & Doering, 2017), the implications of mining space resources (Newman, 2015), build-up of debris in space (Durrieu & Nelson, 2013), the ability to inspire stewardship (Spector et al., 2017), and the need to colonise space to ensure the survival of the human race (Matheny, 2007). There does not appear to be any literature suggesting space tourism will reduce carbon emissions. In fact, Ross, Mills, and Toohey (2010) suggested that commercial space travel could end up significantly contributing to climate change. Their findings were based on models of black carbon particulates that are emitted by the engines expected to be used in many suborbital aircrafts (Ross et al., 2010). Thus, even if commercial space travel is beneficial to sustainability it may still be inconstant with a transition to lower carbon mobility.

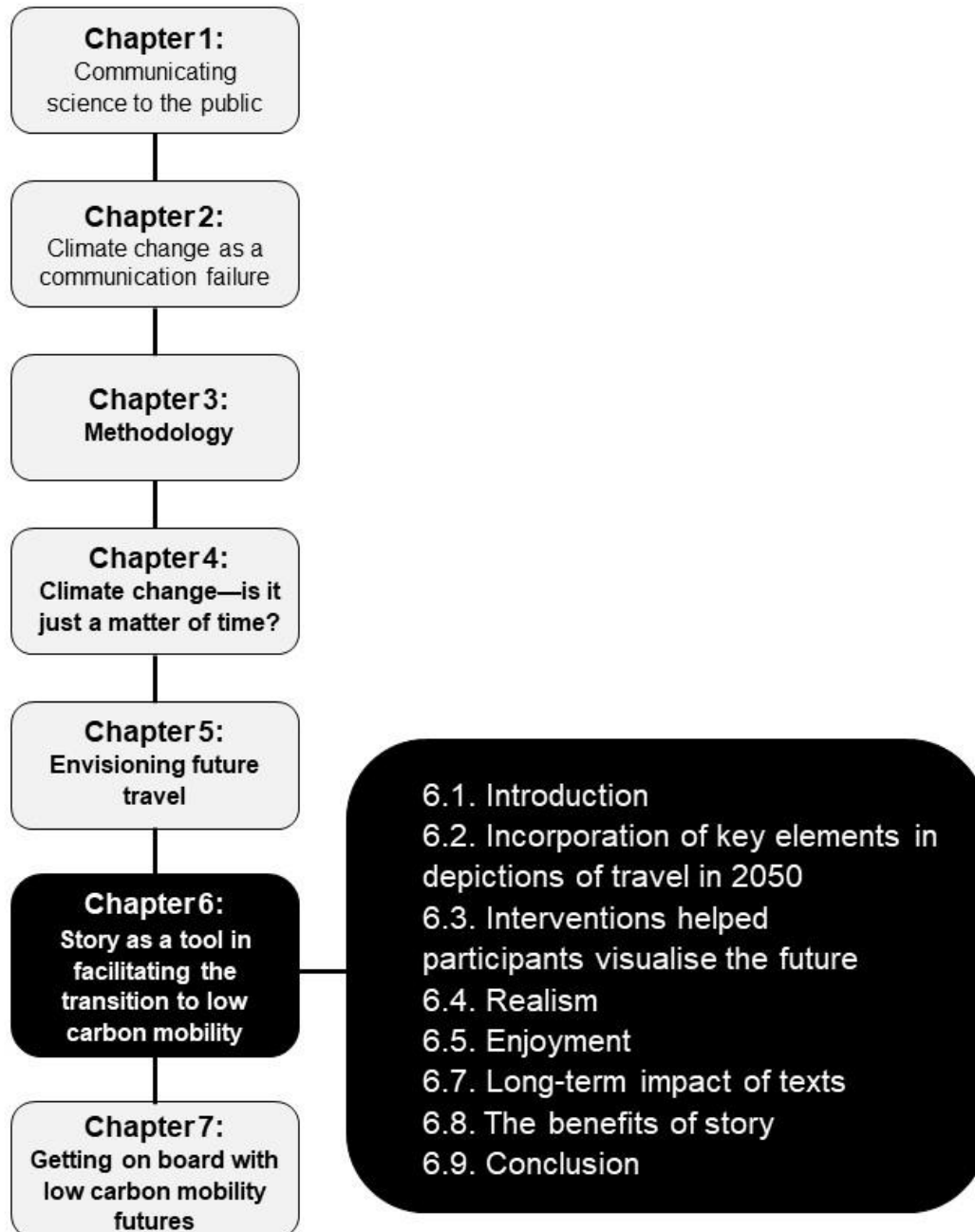
5.5. Conclusion

This chapter focused on the expectations of travel in the year 2050 with respect to low carbon mobility for a cohort with high reported levels of climate change concern, high levels of education, and a younger average age. This was a useful population to investigate as it might be expected that these characteristics would describe those who may be more likely to be thinking about a low carbon mobility future. As in Chapter Four, this chapter found that participants' levels of concern about climate change were related to their likelihood of mentioning low carbon mobility options when discussing future travel. However, despite the high level of concern about climate change and a high level of agreement that climate change will affect both their lifestyle and their travel plans in 2050, less than half of the participants discussed low carbon mobility options. Additionally, participants' expectations that future travel will become cheaper, faster, and more convenient could hinder the transition to low carbon mobility systems and set up a potential paradox between what people expect future transport technology to achieve and what may be realistic.

Addressing these expectations at a cultural, structural and individual level may help reconcile these inconsistencies and facilitate a transition towards low carbon mobility. Governments may be able to address high carbon transport lock-in by enacting structural change to create infrastructure and policies that would increase the speed and convenience of mass transport and make more sustainable transport more affordable, but it is unlikely that they would be willing to implement policies that would restrict travel. Instead, changes would need to be tackled at a cultural level with societies working to change attitudes and values around the social acceptability of high carbon travel. Individuals and society may be also able to create cultural change to modify habits and social norms regarding daily commutes (using less cars and more public transport or bicycles). Relying on the aviation industry to lead the transition to low carbon mobility is unrealistic.

Now that it has been established that participants in both surveys did not necessarily associate future travel with low carbon mobility, the next chapter investigates whether reading a short story or textbook styled intervention set in the year 2050 can influence the participants' perceptions of future travel. This will also help answer the research aim of investigating story as a tool for communicating about climate change.

Chapter 6: Story as a tool in facilitating the transition to low carbon mobility



6.1. Introduction

The aim of this thesis is to explore story as a tool for communication about climate change, specifically low carbon mobility futures. The first two chapters proposed that story may be able to help people visualise low carbon mobility futures (Section 2.9.) and change their expectations of future travel through narrative persuasion (Section 1.4.6.). This chapter addresses the second research question by investigating the influence reading a short story has on participants' ability to visualise the future and the fifth research question by investigating the influence a short story has on participants' expectations of travel in the year 2050.

The previous chapter explored the future travel expectations of a cohort of 401 (See Section 3.4.1.5 for demographic details); when asked to describe travel in the year 2050, only 43% of these participants discussed low carbon mobility options. Chapter Six expands on the results of Chapter Five by presenting an intervention to the same participants. Of the 401 participants from Chapter Five, 350 provided descriptions of travel both before and after the intervention (for more details on how this study was conducted refer to Chapter Three); this chapter focuses on these 350 respondents.

The chapter begins by examining whether participants changed their perceptions of travel in the year 2050 after reading one of two interventions—a short story intervention or a fictional expository textbook styled intervention. Next, it looks at whether certain modes of low carbon travel that were proposed in the texts were more likely than others to be adopted by participants. The chapter investigates factors that could strengthen narrative persuasion such as perceived realism and enjoyment of the texts. It also looks at whether the two interventions had an influence on participants' perceptions of climate change risk and their self-reported ability to visualise the future. The longer-term impacts of the story and textbook interventions on recall and behaviour change are also explored.

6.2. Incorporation of key elements in depictions of travel in 2050

6.2.1. Changes in travel expectations following exposure to the interventions

The fifth research question directly addressing story as a tool for changing perceptions of future mobility systems. To assess whether a short story intervention could influence participants' expectations of travel in the year 2050, seven ideas (key elements) were incorporated into both a story and a textbook intervention. The textbook intervention

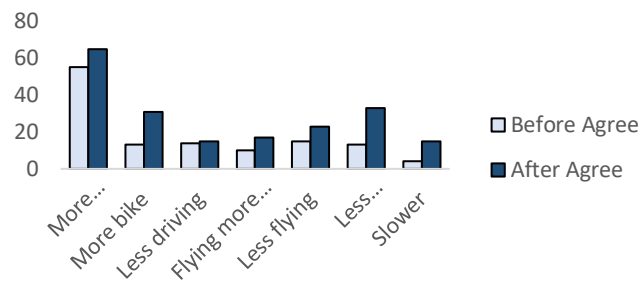
served as a control to help ensure changes in participants' expectations were a result of the story format and not the act of providing information. The key elements used in this study as described in Table 3.3 were:

- greater use of trains, and public transport,
- more cycling,
- less driving,
- flights being more expensive,
- less flying,
- less international travel/ more local travel, and
- slower travel

After completing the first half of the survey, participants were randomly assigned to one of two interventions with 48% ($n = 167$) reading the story intervention and 52% ($n = 183$) reading the textbook intervention. The presence of the key elements in participants' written descriptions of travel in the year 2050 before and after reading the intervention was compared. In their initial depictions of future travel, 76% ($n = 266$) of all participants did not describe any key elements (Appendix Q and Appendix O for coding details). Also in their descriptions of future travel provided before the intervention, 63% ($n = 222$) of participants described travel in a way that contradicted at least one key element (Appendix Q and Appendix O for coding details). For example, one participant stated, "It would be faster, cheaper and more comfortable [Female, Spanish, 18-29, Textbook]."

These results suggest that before reading the interventions many participants envisioned travel in 2050 differently than the texts (for more details about these initial expectations see Section 5.3). A Mann-Whitney Test revealed no significant differences between the pre-intervention responses of participants in the story and textbook groups (key elements mentioned: $N = 350$, $p = 0.187$, contradictions to key elements: $N = 350$ $p = 0.402$). Increased use of trains and public transport was the most common key element mentioned by participants ($n = 55$, 16%) before they read the intervention, while the ideas that there would be less flying ($n = 66$, 19%), less driving ($N = 80$, 23%) and slower travel ($n = 145$, 41%) were the most likely to be contradicted (Figure 6.1).

a) Key elements



b) Information that contradicts key elements

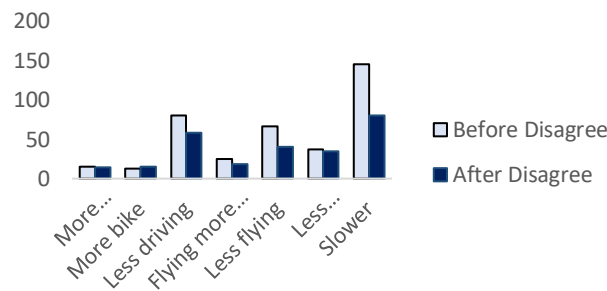


Figure 6.1: The presence of key elements (a) and information that contradicts key elements (b) in participants' descriptions of travel in the year 2050 before and after reading a story or textbook intervention.

After reading the story intervention, participants were significantly more likely to mention key elements (Wilcoxon Signed Ranks Test, $n = 167$, $p = 0.004$, small size effect, $r = 0.22$) (Figure 6.2). This trend was also true for participants who read the textbook intervention (Wilcoxon Signed Ranks Test, $n = 183$, $p < 0.001$, medium size effect, $r = 0.32$) (Figure 6.2). An example of this change is illustrated by a New Zealand respondent who, following the intervention, described future travel as having “No flying and/or cars. More cycling and public transport [Female, New Zealand, 18-29, Story].” This depiction details four key elements compared to her previous statement that travel in 2050 would “Probably [be] more limited than now due to climate change [Female, New Zealand, 18-29, Story].”

Participants in the story intervention were significantly less likely to mention factors that contradict the key elements following the interventions (Wilcoxon Signed Ranks Test, $n = 167$, $p = 0.009$, small size effect $r = 0.20$) (Figure 6.2). This relationship was even stronger in the textbook intervention (Wilcoxon Signed Ranks Test, $n = 183$, $p < 0.001$, medium size effect, $r = 0.34$) (Figure 6.2). This suggests that both the story and textbook intervention were able to change participants' expectations regarding future

travel to become more text consistent. Therefore, the answer to the fifth research question is, yes story can change individuals' perceptions of future mobility systems to reflect the idea of a low carbon mobility future. Additionally, textbook style information can also change perceptions of future travel.

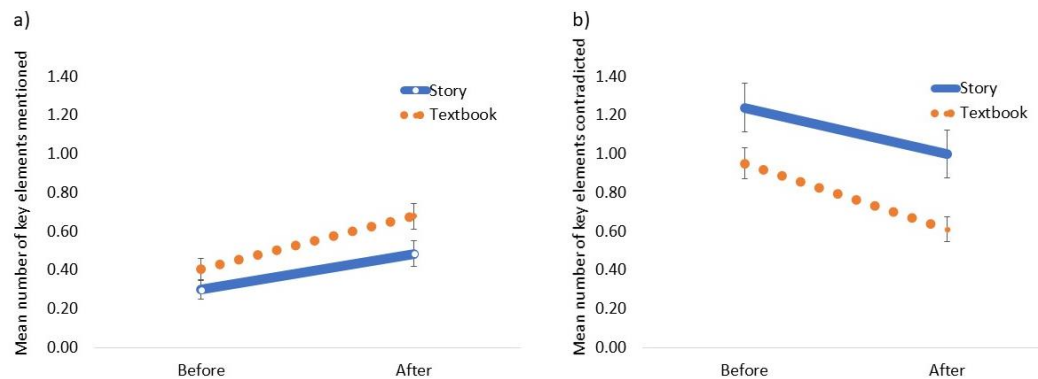


Figure 6.2: Relation between key elements and intervention.

a) Mean number of key elements mentioned by participants in the story and textbook groups before and after the intervention

story (Before: $M = 0.30$, $SD = 0.65$, $ME = 0.05$; After: $M = 0.49$, $SD = 0.67$, $ME = 0.07$)

textbook (Before: $M = 0.40$, $SD = 0.76$, $ME = 0.06$; After: $M = 0.68$, $SD = 0.92$, $ME = 0.07$)

b) Mean number of elements mentioned by participants the story and textbook groups before and after the intervention

story (Before: $M = 1.24$, $SD = 1.62$, $ME = 0.13$; After: $M = 1.00$, $SD = 1.59$, $ME = 0.13$)

textbook (Before: $M = 0.95$, $SD = 1.13$, $ME = 0.08$; After: $M = 0.61$, $SD = 0.88$, $ME = 0.06$)

A Mann-Whitney test found that following the intervention individuals in the textbook group were more likely to describe a greater number of key elements than individuals in the story group ($N = 350$, $p = 0.021$, small size effect, $r = 0.12$) (Figure 6.2). Similarly, the textbook group was also less likely to contradict key elements following the intervention (Mann-Whitney, $N=350$, $p = 0.47$, small size effect, $r = 0.11$). This suggests that the textbook intervention may be more effective at changing participant's expectations of future travel than the story intervention. These results were contrary to initial expectations as the study had been designed with the assumption that by adding persuasive elements to the story intervention, participants in the story group would be more likely to incorporate the key elements into their depictions of travel in the year 2050 than participants in the textbook group. Instead, these results suggest that the persuasive characteristics of the story intervention were not the main driver of expectation change. This could be due to the fact that most of the participants already had a high level

of climate change concern (see Sections 5.2 or 6.7.) and so may have been less likely to argue with the message in the first place, potentially making persuasion less important than an awareness of alternative options

These results are important because they demonstrate that people's expectations of future travel can change. One of the main conclusions of Chapter Five was that participants held unrealistic and often conflicting expectations about travel in the year 2050 and that these conflicting expectations might hinder the transition to low carbon mobility. Being able to change specific expectations regarding future travel may result in individuals having a potentially more realistic idea of what a low carbon mobility future will look like. This may allow people to consider different travel options.

6.2.1.1. Key elements likely to be adopted

Not all of the key elements were equally adopted by participants following the intervention (Figure 6.1). This is interesting because it could suggest that some methods of reducing emissions may be perceived to be more attractive, realistic or acceptable than others. On the other hand, participants in the story and textbook group tended to adopt different key elements following the intervention (Figure 6.1) suggesting that adoption of elements may be influenced by other factors. After the intervention, individuals in the story group were more likely to discuss the idea that there would be more bicycling in the year 2050 (McNemar, $n = 167$, $p = 0.002$) while individuals in the textbook group were more likely to incorporate the ideas that flights would be more expensive (McNemar, $n = 183$, $p = 0.039$), that there would be less international travel and more local travel (McNemar, $n = 183$, $p < 0.001$) and that travel would become slower (McNemar, $n = 183$, $p < 0.001$). Individuals in the textbook group were also less likely to suggest that future travel would involve flying (McNemar, $n = 183$, $p = 0.003$) or driving (McNemar, $n = 183$, $p < 0.001$).

Influenced by the story I just read, I love the idea of slow food, slow travel etc. I'm a cyclist so love the idea of extensive cycle networks, safety, being out in the environment more with less use of fuel etc - enjoyed also because of a warming climate! Fuel will become more expensive and less available so air travel may become inaccessible for many. Also, current generations in NZ are known to be poor savers so many elderly will struggle to afford international travel anyway. Slow travel will be great for the country as more people explore their own area. This may also reduce immigration? [Female, New Zealand, 50-59, Textbook]

International travel will be on mass, or (as per your story) will be for the 'privileged'. On a local basis, I would like to think that cycling will be the norm (as per your story!). [Male, New Zealand, 40-49, Story]

While different from original expectations, it is unsurprising that the textbook intervention resulted in a greater range of key elements being either adopted or less contradicted. As described above, individuals who read the textbook intervention provided a greater number of key elements and were less likely to contradict key elements when compared to individuals who read the story intervention (Figure 6.2). Again, this suggests that the textbook intervention was more effective at changing participants' expectations of travel in the year 2050.

Interestingly, participants in both the story and textbook group were less likely to describe future travel as becoming faster following the intervention (McNemar, $n = 167$, $p = 0.001$ and $n = 183$, $p < 0.001$ respectively). This may be important as before the intervention faster travel was one of the most common expectations of future travel (Section 4.3 and Section 5.3.). Twenty percent ($N = 69$) of participants who initially discussed travel becoming faster did not repeat this idea following the intervention (Appendix Q). As discussed in the previous chapter, speed is a key challenge for sustainable transport (Banister, 2008) and the expectation of fast travel currently conflicts with many modes of low carbon mobility. The finding that this expectation can be is important because it may give participants a more realistic view of how to engage in low carbon mobility. Only participants in the textbook group were significantly more likely to adopt the idea of slower travel. This could be because the term 'slow travel' was explicitly used in the textbook intervention whereas it was only implicitly described in the story intervention. Similarly, the focus of the textbook intervention was on the rise of slow travel while the focus of the story intervention was on chasing a band. Therefore, the idea of slow travel may have been more obvious or memorable in the textbook intervention.

One reason the textbook intervention may have elicited a greater number of changes in participants' expectations could be that it was easier to identify a cause and effect pattern in the textbook intervention than in the story intervention. Causality has been found to increase recall within a narrative (Dahlstrom, 2010, 2012). The textbook intervention suggested that taxes and restrictions from climate change policies led to a

decrease in budget airlines, causing an increase in the cost of flying and an increase in slow travel (Appendix C). Since slow travel took more time people travelled more locally. Additionally, because there was more infrastructure surrounding slow travel, people began driving less. This more explicit causality in the textbook version may have made it easier to link the ideas of flights becoming more expensive, less flying, slower travel, less driving and less international and more local travel. The story version just stated that flying was expensive and that it was no longer considered fashionable to fly internationally for holidays. No reasons for the changes were given, potentially making them less memorable. However, participants in the story group were more likely to mention an increase in bicycling. This is likely because the characters in the story intervention spend a large amount of time on bicycles and it contributed to the plot of the story. In the textbook intervention, cycling was only briefly mentioned.

6.3. Interventions helped participants visualise the future

Almost all participants stated that they could visualise nearer timeframes more clearly than distant timeframes and 53% of all participants described the next 20-50 years as being ‘not at all clear’ (Table 6.1).

Table 6.1: Percent and frequency of participants’ perceived ability to clearly visualise the future at different timeframes

		1 year	1-2 years	5-10 years	10-20 years	20-50 years	50-100 years
Not at all clear	N	8	9	41	108	186	268
	%	2	3	12	31	53	77
Not very clearly	N	16	42	123	147	133	68
	%	5	12	35	42	38	20
Somewhat clearly	N	119	160	158	88	23	7
	%	34	46	45	25	7	2
Very clearly	N	206	137	25	6	5	4
	%	59	39	7	2	1	1

When asked specifically about the year 2050, only 15% of participants said that they could picture 2050 ‘somewhat’ or ‘very clearly’, but this number rose to 27% following the intervention (Figure 6.3). Because participants had trouble visualising the year 2050, they may also have had trouble predicting what travel will be like in the year

2050. A Wilcoxon signed rank test revealed that there was a significant increase in participants' self-reported ability to visualise the year 2050 after reading either the story ($p < 0.001$, medium size effect $r = 0.39$) or textbook intervention ($p < 0.001$, medium size effect $r = 0.40$). A Mann-Whitney test showed no difference between the story and textbook groups either before ($p = 0.382$) or after ($p = 0.832$) the intervention. This suggests that both the textbook and story interventions were equally effective at increasing participants' ability to clearly visualise the year 2050. Each intervention provided a possible example of what future travel could look like. Participants may have felt like they could better visualise the future because they pictured that example given in the texts. If they were using ideas presented in the texts to help them envision the future then it would make sense their subsequent depictions of travel in 2050 become more consistent with the futures presented in the texts.

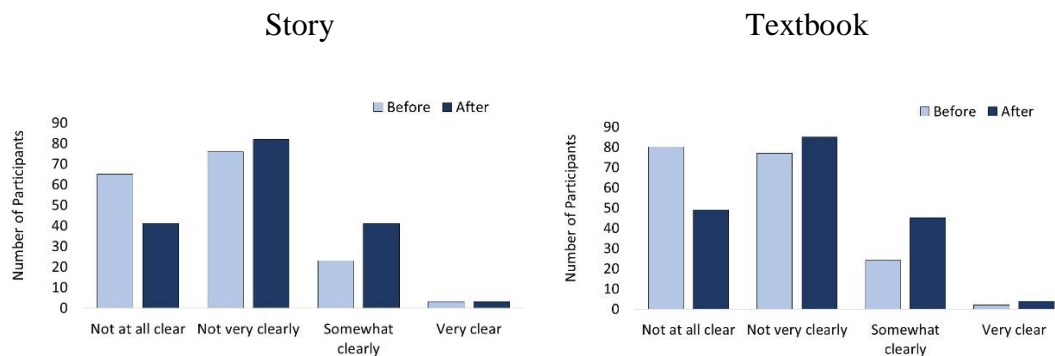


Figure 6.3: Self-reported ability to visualise the year 2050 before and after reading the story or textbook intervention.

6.4. Realism

Another explanation for why participants in the textbook group may be more likely to adopt text consistent expectations could be because the textbook intervention was perceived to be more realistic than the story intervention (Figure 6.4). A Mann-Whitney U-test revealed significant differences in perceived realism between the story and textbook group ($n = 341$, $p < 0.001$, small size effect $r = 0.22$). Almost half (48%, $n = 87$) of the participants in the textbook group either 'agreed' or 'strongly agreed' that the world portrayed in the text was realistic. In contrast, only 23% ($n = 39$) of participants 'agreed' or 'strongly agreed' with this statement in the story group.

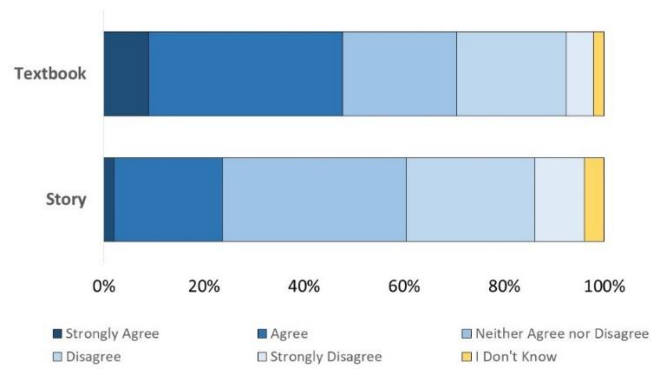


Figure 6.4: Perceived realism of the story (n = 167) and textbook (n = 183) interventions

A Spearman test revealed a weak, positive correlation between perceived realism and the number of key elements listed in both the story and textbook groups (Table 6.2). There was also a weak negative correlation between perceived realism and contradictions to key elements in the textbook group. Again, this suggests that perceived realism may have influenced the adoption of key elements in the textbook intervention. It has been predicted that when narratives are perceived to be more realistic then people are more likely to accept the information within the story and therefore, less likely to engage in counterarguing (Busselle & Bilandzic, 2008).

I'm not sure, but I really like the scenario invented in the story. I hope it comes true. It sounds far more realistic and sustainable and fun. Mass cheap airline travel is a waste of resources and not fun. [Female, Australian, 50-59, Textbook]

Table 6.2: Spearman's correlation and effect size between perceived realism and the number of key elements and contradictions to key elements provided by participants in the story (n = 161) and textbook (n = 180) interventions

		Story		Textbook	
		P	Size effect (R)	p	Size effect (R)
Number of key elements	Before	0.086		0.863	
	After	0.048	0.156	0.007	0.201
Contradictions to key elements	Before	0.620		0.061	
	After	0.226		<0.001	0.294

The fact that the textbook intervention was perceived to be more realistic than the story intervention could help explain why it was more effective at changing expectations to be more text consistent. The perception of realism may have different components including plausibility, typicality, factuality, narrative consistency, and perceptual quality and these components may affect narrative persuasion in different ways (Cho, Shen, & Wilson, 2014). It would be interesting for a future study to try to differentiate between these different components.

Almost one third of participants did not find the texts realistic. One possible reason could be a belief that technological advancements will allow for fast, cheap, convenient and sustainable travel. Alternatively, some participants reported having little faith in society's willingness to change its behaviours. Therefore, while the story and textbook interventions were able to change some participants' expectations regarding future travel, these changes were by no means universal. One participant explained:

I think the same as I did before; I actually think travelling will become cheaper as technology will make up for fossil fuels and climate change's effects. I don't think the global economy will give up on fast easy travel very easily so technology will rise (I hope) to help! [Female, Australian, 30-39, Textbook]

6.5. Enjoyment

The majority of participants (53%) stated that they enjoyed the texts (Figure 6.5). Of the 167 participants who read the story intervention, 74 (44%) 'agreed,' or 'strongly agreed' that they enjoyed the story, 57 (34%) (Figure 6.5). Similarly, of the 183 participants who received the textbook intervention 112 (61%) 'agreed,' or 'strongly agreed' that they enjoyed the text. A Mann-Whitney U-test revealed a significant difference between the two groups ($N = 350$, $p < 0.001$, small size effect $r = 0.21$); this suggests that the differences in the adoption of key elements between the two groups could stem from different levels of enjoyment caused by the different texts.

A Spearman's correlation found that enjoyment was weakly correlated with the number of key elements listed following the intervention in the textbook group (Table 6.3). This suggests that enjoyment may be involved in narrative persuasion. However, the role enjoyment plays may be indirect. Busselle and Bilandzic (2009) found enjoyment to be significantly correlated to story engagement which in turn was significantly correlated

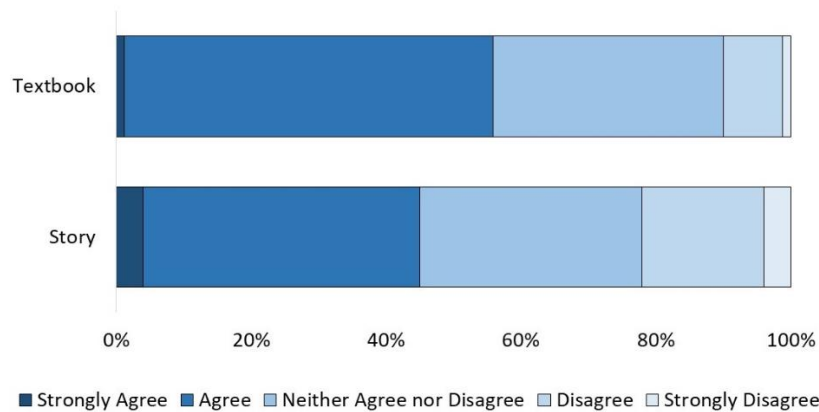


Figure 6.5: Enjoyment of the story (n = 167) and textbook (n = 183) interventions.

to story related attitudes. The same study found that engagement was not significantly correlated with attitudes that were unrelated to the story (Busselle & Bilandzic, 2009). This suggests that people who report higher levels of enjoyment are more likely to adopt ideas that are relevant to the story. This could explain why story participants were more likely to adopt the idea of increased cycling as it was a major plot point. Additionally, enjoyment has also been linked to transportation into text which, in turn, has been linked to narrative persuasion (Green, Brock, & Kaufman, 2004).

Table 6.3: Spearman's correlation and size effect between enjoyment and the number of key elements and contradictions to key elements provided by participants in the story (n = 167) and textbook (n = 167) interventions

		Story		Textbook	
		P	Size effect (R)	p	Size effect (R)
Number of key elements	Before	0.597		0.240	
	After	0.770		0.007	0.200
Contradictions to key elements	Before	0.736		0.315	
	After	0.226		0.950	

6.6. Impact of the story and textbook intervention on participants' climate change risk perception

Neither the story nor the textbook intervention significantly increased participants' levels of concern about climate change (n = 167, p = 0.366 and n = 183, p = 1.000 respectively) (Figure 6.6) and there were no differences in the levels of climate

change concern between those in the story and textbook group either before ($N = 350$, $p = 0.476$) or after ($N = 350$, $p = 0.680$) the intervention.

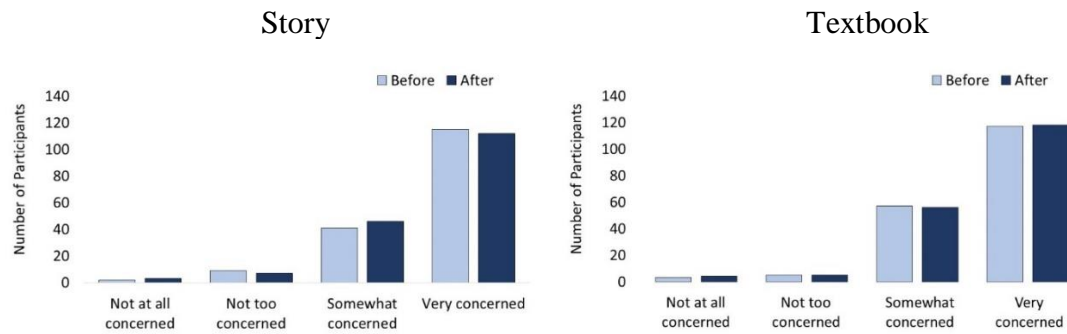


Figure 6.6. Levels of climate change concern before and after reading the story ($n = 167$) and textbook ($n = 183$) interventions

Similarly, out of seven global threats participants in both the story and textbook intervention ranked climate change as the greatest threat, followed by loss of biodiversity (Table 6.4.). These rankings did not change following the intervention (Table 6.4).

Table 6.4: Mean rank of seven global threats by the story and textbook groups.

Global Threat	Overall Rank	Story		Textbook	
		Before	After	Before	After
Climate Change	1	6.30	6.36	6.27	6.23
Loss of biodiversity	2	5.22	5.16	5.06	4.98
Terrorism	3	4.16	4.04	4.61	4.57
Radioactive waste	4	3.88	3.82	3.68	3.64
Nuclear power	5	3.27	2.37	3.23	3.27
Genetic modification	6	2.75	2.87	2.81	2.91
AIDS	7	2.47	2.39	2.42	2.45

Although the story and textbook interventions were unable to inspire change in participants' levels of concern about climate change, this is likely due to a ceiling effect

rather than a reflection of story's ineffectiveness as a persuasive tool. The ceiling effect occurs when an instrument is unable to measure the top end of a scale. In this survey, 66% percent of participants initially reported being 'very concerned about climate change' and 64% of participants ranked climate change as the top global concern. Because these were the highest options available to participants, there was no way for these participants to report any increase in concern that they may have felt following the intervention. These participants could only continue to state that they were 'very concerned about climate change' and rank climate change as the top global treat even if they had become more concerned about climate change.

An alternate possibility to why there was no significant change in climate change concern following the intervention could be that participants did not associate the brief reference to increased storms as being an adverse consequence of climate change since this connection was not explicitly stated in either intervention. An underlying assumption of both The Elaboration Likelihood Model (ELM) of persuasion and the Heuristics systems model of persuasion is that the individual receiving the message recognises the message (Chaiken, 1987; Petty & Cacioppo, 1986). According to these models, how the message is processed will depend on a number of different factors, but the receiver must first recognise the message for message processing and eventually persuasion to occur (Chaiken, 1987; Petty & Cacioppo, 1986). Thus, if participants did not recognise the message that climate change would cause consequences such as increased storms in New Zealand (New Zealand Climate Change Centre, 2010) it would be unlikely that they would change their levels of concern regarding climate change.

6.7. Long-term impact of texts

6.7.1. Text recall

In August of 2017, approximately 15-18 months after participants had completed the survey, a follow-up interview was conducted with 31 of the participants who had indicated a willingness to be contacted again. Out of these 31 individuals, ten (32%) had read the story intervention and 21 (68%) had read the textbook intervention (see Table 3.7). When asked to briefly describe what they think travelling will be like in 2050, three participants in the story group and five participants in the textbook group were able to accurately recall at least one detail of the text. While these recollections did contain some accurate information, there were individuals who misremembered and recalled parts of

the text that did not exist. In the following example, the participant accurately remembered that people were travelling by bike to a lake; however, there were no hoverboards in the story.

Two people going for a bike ride and I think they went to a lake or a town, but I can't remember which. I think they were talking about ways to travel. Bike, vague memory of something obscure like hoverboards. [Female, New Zealander, 20-29, Story]

Some participants described specific details of the texts while others described the underlying messages. One participant remembered the textbook intervention's message that future travel would take more time than it currently does. This is an accurate recollection as the textbook intervention was promoting the idea of slow travel. An additional two participants (one from the story group and one from the textbook group) were able to recall the texts after being provided with a statement aimed at reminding them of the text without giving them details. For example:

Interviewer: So back, probably a year and a half ago, when you did the original survey there was a piece of text embedded in the survey. Any chance you remember anything from it?

Interviewee: No.

Interviewer: No worries. It was a long time ago. So, it was a short story about these friends. They see a band and kinda chase the band around New Zealand. It's set in 2050.

Interviewee: Ah [yes]. They're cycling, and ya I can remember that.

Interviewer: [Yes]. Besides cycling do you remember any of the other ways they were getting around New Zealand?

Interviewee: I think they got on a train at some point and maybe they rented an electric car or something. I can't remember.

There is evidence from other studies suggesting that recall is higher for story than fact-based texts (see Section 1.4.1.). This does not appear to be the case in this study, although low sample size precludes meaningful statistical analysis. In both interventions, approximately one third of the participants interviewed were able to remember a part of the text. However, when recounting the texts participants did not talk about how frequent future travel would be without specifically being asked. This suggests that this reduced frequency of travel was not a memorable idea.

6.7.2. Behaviour Change

In the interview, participants were also asked if they had changed their travel behaviours or the way they think about travel in the last 18 months (i.e. the time since they did the original survey). Twenty participants (65%) said they had. Of these, 12 people talked about changing behaviours or thinking that promote low carbon mobility. This came in the form of: becoming more aware of the environmental impacts of travel, having the perception that the travel industry was beginning to change in response to environmental concerns, less international flying, more local travel, less car use, switching to an electric car, more walking and more cycling.

We bought an electric car, so that's changed [the way we travel] dramatically. My thinking about travel hasn't changed. I am still committed to a low carbon transport system, but my ability to do something about it has changed through material change. [Male, New Zealand, Story]

Seven participants talked about their travel habits changing to become less environmentally sustainable. This was because they started to see travel as more of a normal thing due to an increase in international travel, and/or an increase in car use.

I've recently moved up to Auckland. I used to walk a lot when I was down in Dunedin. I'd walk to uni, I'd walk to meet my friends at cafes because I could. In Auckland I can't do that. Either it is too far away or there aren't good enough footpaths so I'll take public transport or get rides a lot more often for day to day commuting stuff. And then domestic travel, I also travel a lot more because I am now in full-time work which means I have the money to afford to, and also because my friends, a lot of them are still down in Dunedin, I want to go see them so I have more of a reason to travel as well. [Female, New Zealander, 18-29, Textbook]

Interestingly, one participant talked about how location impacted how they thought about travel. She noted that after travelling to Canada she thought flying was very common, but in Europe it was more common to take the bus. This highlights the idea that modes of transportation are influenced by context and culture.

A common reason for participants to change their travel behaviours was because of a change in situation (e.g. moved city/house, new job, a physical change such as an injury or pregnancy). Two participants stated that their travel behaviour had changed because of the rise in terrorist attacks or for political reasons. No one specifically credited the texts to inspiring them to change their travel behaviour, although one participant did say it changed the way she thought about travel.

[Reading the text] didn't really affect how I actually travel, but [that text] is still in my mind...In the first part [of the survey before reading the text], I was probably talking about [how] I hope I can travel faster and things, but after I read the text I changed mind and I started to think [that] I should accept the [the large amount of] time that [travelling takes]. [Female, Japanese, 20-29, Textbook]

It is not surprising that participant's behaviours did not become more environmentally sustainable due to narrative persuasion as a study by Appel and Mara (2013) investigating the role of narrator trustworthiness in narrative persuasion found they were able to change university students' driving intentions to be more environmentally sustainable but when the students were resurveyed three weeks later, they had not significantly changed their behaviours. In the follow-up interview, one participant notably stated that his opinions regarding the likelihood of transitioning towards low carbon travel had changed in the time since completing the original survey. This was in response to policy changes that happened in 2017. His quote highlights the idea that although at times it may seem like there are too many barriers for travel to ever transition to low carbon mobility if these barriers can be overcome transition is possible.

I think I put in the survey [back then] that I didn't think travel would change that much, but recent announcements, like very recently, about the U.K. introducing a ban on fossil fuel cars has had an impact on that. ... I didn't think it likely that we would move away from fossil fuels by [2050], but now I am starting to think it's more likely that we are going to. [Male, New Zealander, 30-39, Textbook]

6.7.2.1. Perceived barriers to behaviour change

In the follow-up interview, participants were asked if there was anything they would like to change about the way they travel but just had not been able to. Common responses were that participants would like to cycle more, use a car less, use more public transport, fly less and travel more (including more international travel). Perceived barriers to cycling more included safety concerns, lack of cycling infrastructure, large distances, time and weather.

I would love to be able to bike everywhere (at the moment I use the bus system). I wish I could bike more but in Duendin, the bike system isn't very well developed, I don't think. I don't feel safe on the roads. [Female, New Zealander, 18-29, Textbook]

Reasons participants said it was difficult to decrease their car use included that: they needed to travel distances that were difficult to travel using other modes of transportation,

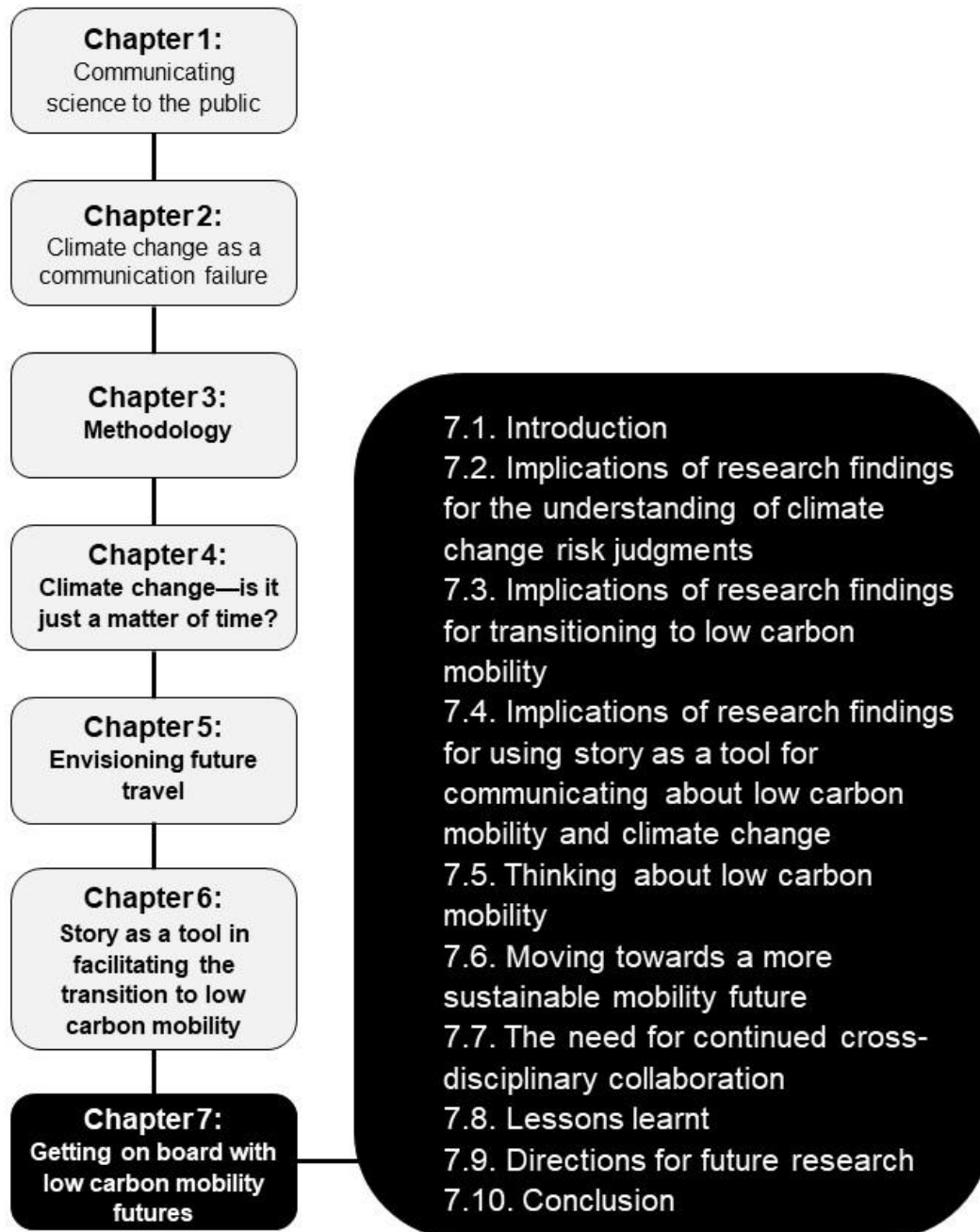
it made running errands with children easier, and public transportation was not able to meet their needs. Similarly, perceived barriers to using public transportation included high cost, lack of service (not available at certain times or to certain destinations), slowness, and inconvenience. Lastly, perceived barriers to decreased flying included wanting to visit family who live far away and the large amount of time it takes to travel using other modes of transportation, while perceived barriers to travelling more were cost and time.

As many of these perceived barriers are the same as those identified in Chapter Five, it reinforces the idea that conflicting priorities may hinder the uptake of low carbon mobility. These conflicting sentiments were summarised nicely by one of the participants in the follow-up interview when she said, "This mass tourism is awful. It's unsustainable and yet, I really love travelling [Female, German, 50-59, Textbook]." This sentiment is why Miller et al. (2010) suggested it may be easier to encourage more environmentally sustainable tourism by promoting local holidays and using more environmentally sustainable modes of transport than to persuade people to travel less.

6.8. Conclusion

This chapter investigated the impact of reading a text intervention on participants' expectations of future travel. The main impact of reading the story intervention was that it changed participants' expectations of future travel to become more text consistent; however, the textbook intervention was more effective at changing expectations. Participants found it easier to visualise the year 2050 after reading either text. Together this suggests that story and expository text may help participants visualise future low carbon mobility systems. Perceived realism and enjoyment of the texts were both weakly correlated to the number of key elements that were mentioned or contradicted indicating that they may be important elements of narrative persuasion. Neither text influenced participants' perceptions of climate change risk and it is unlikely that texts alone will inspire an uptake in low carbon mobility travel. Instead, this chapter proposes the idea that stories may be a useful tool for discussing low carbon mobility because they can encourage people to think and reflect on how they travel. Similarly, story may be a useful tool for starting needed reflections and discussions around the transition to low carbon mobility systems. The final chapter reviews the major findings of this research and discusses implications for transitioning to low carbon mobility.

Chapter 7: Getting on board with low carbon mobility futures



7.1. Introduction

Communicating about climate change is imperative, yet has been historically problematic for science communicators (Kahan, 2015; McCright & Dunlap, 2011a). This thesis explored story as a tool for communicating about climate change. Future travel provides an appropriate context for this investigation given that transportation is a significant and rapidly growing source of carbon and other GHG emissions (IPCC, 2014). Not only is transport a growing driver of anthropogenic climate change, but the fastest growing sectors including aviation and private vehicle use, are also the most energy intensive modes of transportation (Creutzig, 2016). The climate stabilising goals set by the Paris Climate Agreement will be impossible to meet in the absence of low carbon transitions in the transportation sector; this must change in order to meet global and regional mitigation goals (Sims et al., 2014).

Communicating about the distant future is important as it was hypothesised that participants' perceptions of climate change would be influenced by both their ability to visualise the distant future and their optimism regarding the distant future. The year 2050 was selected to represent the distant future because it was difficult to visualise (Tonn et al., 2006), far enough in the future to allow for large scale structural change in transport systems but still within the expected lifespan of many participants (Frittaion et al., 2010). Additionally, the year 2050 was used as a reference point in the latest IPCC report (IPCC, 2014) and a limited literature does address the future of travel and the prospects for low carbon mobility in 2050 (Åkerman, 2005; Ceron & Dubois, 2007; Yeoman, 2012).

Determining whether story could influence participants' expectation of future travel first required ascertaining their perceptions of future mobility systems. Participants in both the Temporal Distance Survey (Chapter Four) and Story Survey (Chapter Five) were asked to describe their thoughts on how travel in the year 2050 may differ from current travel practices. The results provide insight into potential trajectories for future travel since public opinion can inform policy (Burstein, 2003) and customer opinion is important in the design of new products (van Kleef, Van Trijp, & Luning, 2005) as well as understanding changing market environments (Birn & Forsyth, 2002).

This chapter begins with a review of the main empirical findings that emerged from this research. It then discusses how these findings contribute to the literature on how the public judges climate change risk, story as a communication tool, and the transition

to low carbon mobility. Within this discussion, the benefits and challenges of using story are considered. Next, the chapter contemplates how to encourage the transition to low carbon mobility based on participants' responses. A call is made for continued collaboration between science communication, travel and tourism researchers followed by suggestions for future research. The chapter concludes with a final reflection on story, communication and the transition to low carbon mobility.

7.2. Implications of research findings for the understanding of climate change risk judgments

One of the lines of inquiry of this thesis is how individuals judge climate change risk. This research was conducted at an interesting and critical time in history with respect to climate change. The Temporal Distance Survey was administered in the United States in late October 2016. This was almost one year after the United States attended the 2015 United Nations Climate Change Conference where the Paris Agreement was drafted and a few weeks before climate denier Donald Trump (Figure 2.1.) won the 2016 American presidential election. Therefore, the results from the Temporal Distance survey provide insight into the American public's perception of climate change risk at this time. The results from the Temporal Distance Survey found that the American participants perceived climate change to be a serious threat (Section 4.2.3.). It found that 44% of participants were very concerned about climate change with an additional 30% saying they were somewhat concerned. These results are consistent with the findings of a 2015 poll conducted by the Pew Research Center that found that 45% of Americans were very concerned about climate change and 29% were somewhat concerned. It also aligns with a March 2016 study from the Yale Program on Science Communication which identified 45% of Americans as being either alarmed or concerned (i.e. they believe climate change is a serious problem) (YPCCC, 2016). Additionally, out of seven global threats U.S. participants in the Temporal Distance Survey ranked climate change as the second most threatening, after terrorism.

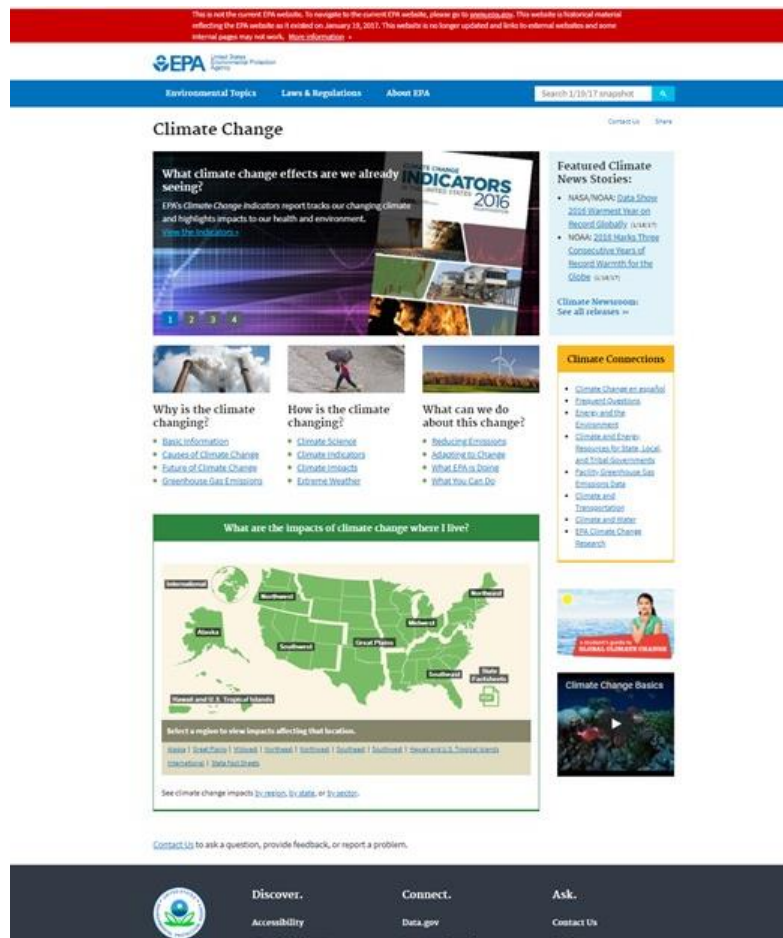
Compared to how people in Great Britain ranked the threats 12 years earlier, the Americans in the Temporal Distance Survey perceived climate change to be a greater threat (Lowe et al., 2006). While it is possible that Americans are more concerned about climate change than people in the U.K., polling data suggests a better explanation for this difference is due to the fact that levels of concern about climate change have risen over the last decade (Gallup, 2011; Pew Research Center, 2015, 2017). This increasing

acceptance of climate change as a serious threat is important because a representative study of Americans found that worry about global warming was the strongest predictor of supporting climate change mitigating policy (Smith & Leiserowitz, 2014). Therefore, this increasing concern about climate change could lead to action that will limit the negative consequences of climate change. Many people want reduced carbon emissions, as demonstrated by the ratification of the Paris Agreement (2015), as well as the public outcry and independent commitment to climate change mitigation at the state and city level following the United States' subsequent withdrawal from the Paris Agreement (Bromley-Trujillo, 2017). The fact that there has been a shift regarding the public's recognition of climate change as a threat may mean that researchers and practitioners need to also shift their focus from trying to convince the public that climate change is a problem to identifying ways to engage people in solving the problem of climate change.

This research was conducted before the election of the American President Donald Trump. Under the Trump administration, government websites such as the Environmental Protection Agency (EPA) were forced to update their content to remove information about climate change (see website text in Figure 7.1b). Figure 7.1a shows a snapshot of the EPA's climate change webpage under the Obama administration dated January 17, 2017, while Figure 7.1b shows the same webpage under the Trump administration (May 5, 2018). The lack of information about climate on the current version of the EPA website may signal to some people that climate change is not a threat. Data from the Pew Research Center (2017) showed that a similar number of Americans considered global warming to be a major threat in both the spring of 2016 and 2017 (53% and 56% respectively), suggesting the American government's position on climate change may not have a significant influence on public risk perception. However, if the American government persists to denounce the threat of climate change it would be interesting to investigate perceptions of climate change risk in the American public in the year 2020 to explore whether the administration's prolonged lack of concern about climate change positively or negatively influences public perceptions.

The first research question hypothesised that temporal distance would impact individuals' perceptions of climate change risk. The effect of temporal distance was assessed using participants' perceived ability to visualise the distant future (the year 2050), their future optimism and their attitudes towards technology (Chapter Four). Since none of these factors was found to be significantly correlated to participants' levels of

a) January 17, 2017



b) May 5, 2018

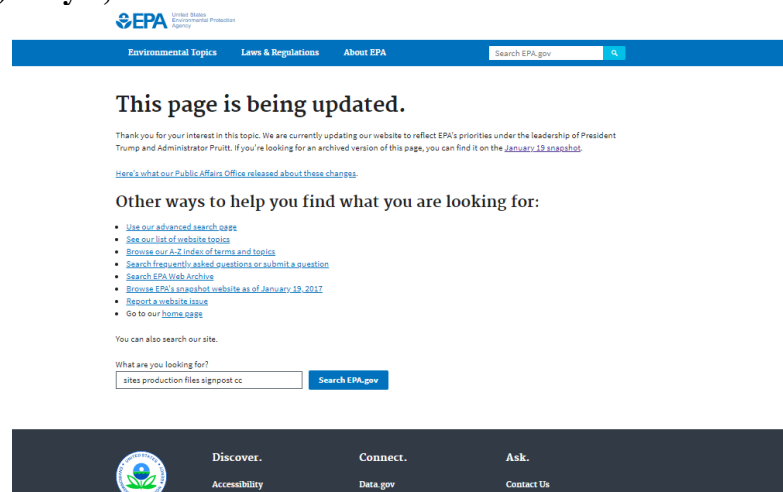


Figure 7.1: An archived snapshot dated January 17, 2017 (a) and a current snapshot from May 5, 2018 (b) of the United States EPA's webpage on climate change.

concern about climate change, contrary to the initial hypothesis, the results suggest that ability to visualise the distant future (Tonn et al., 2006), and future optimism (Lorenzoni et al., 2007; Newby-Clark & Ross, 2003) were not significant influencers of participants' assessment of climate change risk. Therefore, the first finding of this research is that temporal distance does not appear to be a significant influencer of participants' judgement of climate change risk (Chapter Four).

These results differ from those reported by Spence et al. (2012) who found that temporal distance was correlated to levels of climate change concern. One explanation for the discrepancy between the results in this thesis and the study by Spence et al. (2012) is that this thesis assessed temporal distance independently of climate change. Instead of asking participants what year they thought climate change would affect their area as Spence et al. (2012) did, temporal distance was measured through participants' self-reported ability to visualise distant futures, future optimism and technological optimism (Chapter Four). It may be that *perceived* distance is more influential in determining climate change risk than an ability to conceptualise the distant future. Carmi and Bartal (2014) found that perceived temporal distance overshadowed people's levels of climate change risk as individuals could report a high level of concern about an issue but if they thought it posed a distant threat, then the issue was perceived to be less risky. Researchers wanting to replicate or build on this thesis should consider adding a question on the perceived temporal distance of climate change. When trying to change individuals' perceptions of climate change risk it seems likely to be more useful to focus on communicating the more immediate impacts of climate change rather than more severe distant impacts. To increase the chance that climate change is recognised as a serious threat, climate change needs to be framed as a current threat and not a distance threat.

7.2.1 Cognitive dissonance as a potential mediating factor of climate change risk perception

Since the original model suggesting that temporal distance influences people's ability to judge climate change risk was not supported by the results, an alternate model is needed. A reoccurring theme throughout this thesis was the idea that individuals have conflicting attitudes and expectations regarding future travel and climate change. This creates an environment for inner turmoil and cognitive dissonance. Because of this, cognitive dissonance may be a more useful framework than temporal distance for exploring climate change risk perception. Returning to the literature, a new, alternative

model was constructed. This alternative model proposes that climate change risk perception is mediated by the cognitive dissonance which can arise from interactions between individuals' knowledge, worldviews, and perceived control (Figure 7.2).

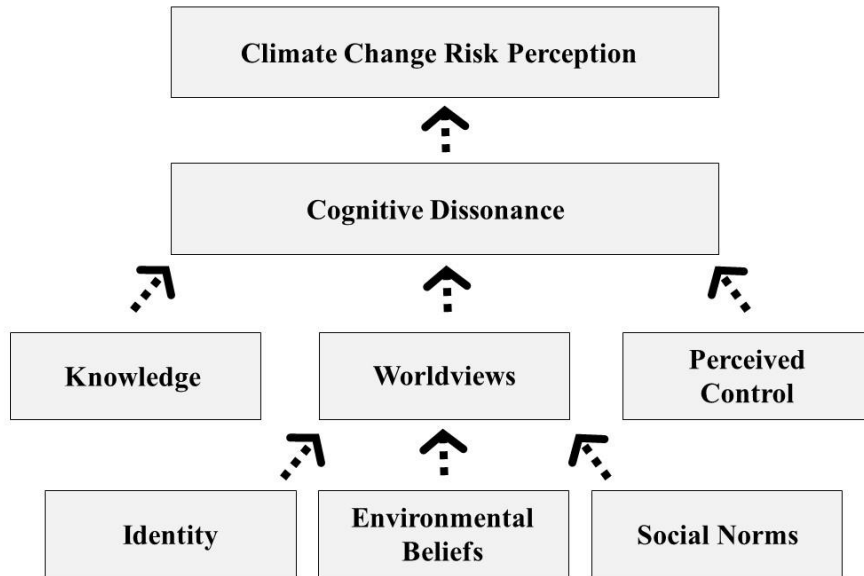


Figure 7.2: Alternate theoretical framework of climate change risk perception (influenced by: Festinger, 1962; Longenecker, 2016; McKimmie et. al, 2003; Nordgren, Van der Pligt, & Van Harreveld, 2007).

Knowledge is a central component of cognitive dissonance (Festinger, 1962). With respect to climate change risk perception, a study from the German speaking area of Switzerland found that people with more knowledge about climate change, the causes of climate change, and the consequences of climate change were more like to be concerned about climate change (Tobler, Visschers, & Siegrist, 2012). Similarly, a cross-cultural study investigating the relationship between individuals' climate change knowledge and their levels of concern about climate change in Canada, China, Germany, Switzerland, the U.K. and the U.S. found that knowing about the causes and consequences of climate change increased the likelihood of a person being concerned about climate change (Shi, Visschers, Siegrist, & Arvai, J., 2016). However, the study also noted that

not all types of climate change knowledge were related to increased levels of climate change concern (for example physical knowledge about climate change had little or even a negative influence) (Shi et al., 2016).

While knowledge about climate change is important to climate change risk perception, worldviews have been shown to shape individuals' perceptions of that knowledge (Kahan et al., 2012). It has even been argued that worldviews are better predictors of climate change concern than science literacy (Kahan et al., 2012; Libarkin, Gold, Harris, McNeal & Bowles, 2018). Interestingly, Stevenson, Peterson, Bondell, Moore, & Carrier (2014) found that knowledge about climate change was a better predictor of belief in anthropogenic climate change in American middle school students than worldviews. They speculate that because worldviews are still being formed at this age, they may hold less influence on how information is processed (Stevenson et al., 2014).

Sense of identity affect how we receive information, what we do with it and how we act on it (Longnecker, 2016). According to Kahan et al.'s (2007) theory of cultural-identify-protective cognition, information that conflicts with an individual's cultural values (worldviews) or the values of the group that they identify with, is likely to be dismissed. This could explain why people subscribing to different worldviews (Cook & Lewandowsky, 2016) or political affiliations (Hart & Nisbet, 2012) can react differently to the same climate change information. For instance, those who identify as politically conservative are more likely to defend current economic systems (Jost, Nosek, & Gosling, 2008), and less likely to believe that climate change is a serious threat (McCright & Dunlap, 2011a, 2011b; Myers, Nisbet, Maibach, & Leiserowitz, 2012; Pew Research Center, 2015). Since current economic systems contribute to climate change, defending the current economic system could conflict with beliefs supporting climate change mitigation. Therefore, it is unsurprising that those who defend these systems would hold lower levels of climate change concern in order to reduce cognitive dissonance (McCright & Dunlap, 2011a).

Linked to the idea that identity influences attention to information is the idea that social norms affect response (Longnecker, 2016). Research from Australia found perceived social norms to be positively correlated to participants' perceptions of flooding risk (Lo, 2013). This may be important as flooding is one of the expected outcomes of

climate change (IPCC, 2014). American middle school students were more likely to be concerned about climate change if they perceived that their family and friends believed in anthropogenic climate change suggesting that perceived subjective norms can influence climate change risk perceptions (Stevenson, Peterson, & Bondell, 2016). Social norms could contribute to cognitive dissonance with respect to climate change if common societal behaviours (e.g. driving fossil fuel vehicles and flying) conflict with climate change mitigating actions. Studies on littering (Cialdini et al., 1990), electricity consumption (Schultz et al., 2007), and towel washing habits in hotels (Goldstein et al., 2008) have shown that social norms can be used to change environmental behaviours and so it may be possible to use social norms to encourage climate mitigating behaviours.

It is also possible that social norms decrease the need for individuals to reduce cognitive dissonance. A study of 99 Dutch psychology students aimed to create cognitive dissonance within participants by first asking them about their attitudes regarding generosity and then asking them to report how often they engaged in generous actions before finally re-evaluating their attitudes (McKimmie et al., 2003). These participants had been separated into different conditions which received different information regarding whether i) the researchers were interested in individual results or university-wide results and ii) how common it was for other students at the university to engage in generous behaviours (McKimmie et al., 2003). The researchers found that participants were less likely to change their answers after noticing the inconsistency between their attitudes and behaviours if they were told either that their behaviours were similar to those of other students from their university, or that the researchers were more interested in individual responses (McKimmie et al., 2003). With respect to climate change risk perception, this suggests it may be possible for people to reduce their cognitive dissonance without having to change their attitudes or behaviours so long as they perceive others to act in a similar manner. For example, cognitive dissonance that could arise from flying might be reduced simply by witnessing others on the same flight.

The Temporal Distance Survey in this thesis found that environmental attitudes were correlated to levels of climate change concern; therefore, it is important to include environmental beliefs in this new, alternative model. Other studies have also reported a correlation between environmental beliefs and concern about climate change (Hidalgo & Pisano, 2010; Libarkin et al., 2018; Milfont, 2012). In Taiwan, environmental beliefs have been linked to individuals' exposure to and their attention given to climate change

coverage online, in newspapers and on television (Huang, 2016). Again, this illustrates how beliefs can influence the way information is or is not received. If information from the media has the potential to cause cognitive dissonance, individuals can ignore or avoid that information (disengage) to reduce their internal dissonance or perceived self identity.

Lastly, perceived control influences response to information (Longnecker, 2016) and so may also influence climate change risk perception. A study from the Netherlands using undergraduate psychology students found a negative correlation between risk perception and the perceived control an individual has over the outcomes of the risk (Nordgren, Van der Pligt & Van Harreveld., 2007). The same study also found a positive correlation between risk perception and perceived control over an individual's exposure to the risk (Nordgren et al., 2007). This suggests that how people perceive risk depends on how avoidable they believe that risk to be. This has interesting implications for climate change risk perception because, although climate change can be mitigated (which would reduce the exposure to the risk) it requires collective action. If people feel that they do not have control over the actions of others, climate change could feel like an uncontrollable risk. Alternatively, individuals may feel that they do not have the control to change the current systems that support high carbon mobility. It should be noted that a New Zealand study found no significant correlation between climate change risk perception and perceived powerlessness nor the commons dilemma (Aitken, Chapman, & McClure, 2011).

It would be interesting to see how well this new, alternative framework explains the results from the Six Americas research. Many of the questions asked in the Six Americas survey could be applied to this cognitive dissonance framework. The Six Americas survey explored participants' identity (religion, political attitudes, ideology, values, and traits), environmental beliefs and concerns, social norms (interpersonal communication and social influences), knowledge (belief and certainty about global warming, self-assessed knowledge, knowledge about causes, and knowledge about scientific consensus), perceived control (expected effectiveness of actions) and risk perception (Maibach, et al., 2009). The Six Americas framework illustrates how these factors can interact to shape individuals' engagement with climate change, however, it would be useful to further investigate the role cognitive dissonance plays in mediating these interactions.

7.3. Implications of research findings for transitioning to low carbon mobility

Although transport researchers are aware that mobility systems need to change in order to meet international carbon reduction targets (Scott et al., 2016), it was unknown whether participants would assume that future travel would involve low carbon mobility. To avoid priming participants, the surveys were designed so that initial expectations about travel in the year 2050 were collected before participants were asked about their attitudes regarding climate change (Appendix A and F). This research found a weak, positive correlation between levels of concern about climate change and mentioning low carbon mobility in both the Temporal Distance Survey ($r(1036) = 0.156, p < 0.001$) (Section 4.2.4.) and Story Survey ($r(399) = 0.114, p = 0.023$) (Section 5.2.). Therefore, the second research finding of this thesis is that participants' levels of concern about climate change were correlated to their descriptions of future travel and whether it involved low carbon options in the year 2050 (Chapters Four and Five).

Despite the correlation between levels of climate change concern and expectations of low carbon mobility, only 28% of participants in the Temporal Distance Survey (Section 4.2.1.) and 43% in the Story Survey (Section 4.2.1.) discussed future travel as being low in carbon intensity, suggesting that the majority of participants did not associate future travel with low carbon mobility. While participants in the Story Survey were more likely to mention low carbon travel than participants in the Temporal Distance Survey, the proportion who did so was still less than half of all participants. This is interesting considering the high level of climate change concern reported by participants in the Story Survey. Thus, the third finding of this thesis is that many participants do not initially associate future travel with low carbon mobility (Chapter Four), even in a cohort reporting high levels of concern about climate change (Chapter Five). Therefore, simply being concerned about climate change is not necessarily enough to expect future travel to be low carbon.

Assuming a low carbon mobility future is desirable and possibly essential, there are two reasons why it would be beneficial to have people expecting a low carbon mobility future. First, if individuals think of low carbon mobility as inevitable they may be less resistant to change. Englehardt et al. (2016) noted that perceived inevitability is

linked to public acceptance. Some cities are trying to reduce the number of cars driving within their city limits (Nieuwenhuijsen & Khreis, 2016); Norway is aiming to transition to 100% emission free vehicles by 2025, with India considering following suit by 2030 (Chrisafis & Vaughan, 2017; Eisenstein, 2017). If individuals start thinking of car free cities as being inevitable they may be less resistant to policies restricting car use and more supportive of policies that support alternative options such as cycling or public transport. Perceived inevitability of marriage equality was one reason given by Americans for why they changed their views regarding same-sex marriage (Herek, 2015). Herek (2015) suggested that attitude change regarding inevitability could result from trying to fit into changing social norms. Therefore, if people start perceiving low carbon mobility systems as being an inevitable change due to a shift in social values their attitudes regarding high and low carbon systems might change so that they fit in with social norms.

A second reason it would be beneficial to have people expecting a low carbon mobility future is that if individuals expect future mobility to transition to low carbon systems they may adopt low carbon technology sooner. For example, if an individual expects mobility systems to switch from petrol to electricity, they may be more inclined to purchase an electric vehicle the next time they buy a car. Unfortunately, studies profiling early adopters of electric vehicles have not included perceptions of future mobility systems in their investigations, making it difficult to determine the extent to which perceived inevitability may influence purchase behaviours. However, studies have found environmental attitudes to be an important predictor of purchasing electric vehicles (Carley et al., 2013; Morton et al., 2017; Plötz et al., 2014). Considering this thesis found 1) environmental attitudes were correlated to levels of climate change concern (Section 3.3) and 2) levels of climate change concern were correlated to expectations of low carbon mobility futures (Section 3.2.4 and Section 4.2), it is reasonable to expect that perceptions of future travel could influence an individual's purchase behaviour.

Interestingly, a study by Egbue and Long (2012) found that although 79% of American participants stated that they consider environmental sustainability when purchasing a vehicle, they were unlikely to consider electric vehicles because they were sceptical about how sustainable electric vehicles were. This was mainly due to concerns about how electricity was generated (Egbue & Long, 2012). This highlights the importance of taking a holistic approach when depicting low carbon futures. In this case, envisioning a low carbon *mobility* future may be dependent on envisioning a low carbon

energy future. Another thing to consider is that mainstream consumers in the U.K. stated that they were unwilling to purchase electric cars in 2010 because they perceived the technology and supporting infrastructure to be ‘works in progress’ (Graham-Rowe et al., 2012). Thus, people may wait to adopt low carbon technology until they believe the technology has reached a competitive level.

According to Roger’s (2010) Diffusion of Innovations model, this “wait and see” attitude is typical of the majority of adopters (both the early majority and the late majority). The perception that the current infrastructure does not support low carbon modes of transport such as electric vehicles reinforces the notion of system lock-in and individuals feeling like they are unable to change because of the larger systemic restrictions (Unruh, 2000). The Theory of Planned Behaviour (TPB) argues that individuals are less likely to change their behaviours when they perceive themselves to have little control and are locked-in to their current behaviours by outside factors (Ajzen, 1985). Rather than convincing the public that low carbon mobility is a distant inevitability, it may be more important to convince them that current systems have changed to support low carbon mobility (Rogers, 2010). The Theory of Integrated Model of Science Communication (IMSC) (Longnecker, 2016) argues that individuals are more likely to adopt behaviours that are consistent with their values as long as there is support (in this case infrastructure and perhaps financial incentives) and social incentive.

It is possible that people’s concern about climate change may not translate to a desire to transition to low carbon mobility. However, the fact that references to low carbon mobility were correlated to levels of climate change concern implies that participants who were concerned about climate change were more likely to expect future travel to be less carbon intensive because they want anthropogenic climate change to be mitigated (Section 4.2.4 and Section 5.2). Therefore, increasing people’s concern regarding climate change could change their expectations of future travel. Individuals who do not believe that climate change exists and individuals who do not believe climate change is anthropomorphic in nature would not be expected to believe that vehicles contribute to climate change. This could explain why polling results show American Republicans were less likely than Democrats to agree a) that climate change is caused by humans and b) that implementing transport actions such as stricter regulations for fuel efficiency and increasing the number of people driving hybrid cars would have a noticeable impact on climate change (Pew Research Center, 2016).

Another important point to consider is that the two surveys reported in this thesis asked participants to describe their perceptions of future travel but did not ask them to make any changes (immediate or otherwise) to their travel behaviours. The surveys did not promote behaviour change nor imply that participants needed to change their mobility behaviours. Even as a distant hypothetical option, some participants voiced resistance to ideas proposed in the texts, instead relying on technological solutions. For example, one participant stated, “I still think [future travel] will be faster and more ecological, I have faith in technological progress [Female, Italian, 18-29, Textbook].” This is concerning as visualising a desired future is much easier than achieving that future.

If participants are resistant even to the idea of a low carbon mobility future it will be very difficult to convince them to engage in low carbon mobility behaviours. Psychological, social, institutional and information barriers and/or constraints have been identified as reasons that an individual’s behaviours do not always reflect their environmental attitudes (Kollmuss & Agyeman, 2002; Longnecker, 2016; Newton & Meyer, 2013). Personal identity and internal factors help determine an individuals’ response to information (Longnecker, 2016). Internal barriers may help explain why reliance on personal vehicles persists in cities despite structural changes that support low carbon mobility (Fishman et al., 2014; Schwanen, 2015). Since different people will have different barriers preventing them from considering transitioning to low carbon mobility systems, overcoming this resistance may require multiple solutions. For this reason, identifying the factors behind people’s resistance to the transition to low carbon mobility systems is an important step in realising this transition.

7.4. Implications of research findings for using story as a tool for communicating about low carbon mobility and climate change

7.4.1. Benefits to using story as a tool for communicating

This thesis set out to determine if story could be a useful tool for communicating about climate change. The results suggest that science communicators should consider employing story when they are seeking to encourage individuals to visualise alternative low carbon futures. Participants in both the Temporal Distance Survey and Story Survey reported that they found visualising the year 2050 difficult (Section 4.2.1. and Section 6.3.). This is consistent with results from Tonn et al. (2006) who found people struggle to picture 20-50 years in the future. This lack of clarity could make it hard for participants to envision unfamiliar low carbon systems, causing them to instead rely more on their

past experiences with high carbon systems when constructing their ideas about the future (Szpunar, 2010). Even experts can find it challenging to visualise future low carbon systems (Howarth, 2017). Howarth (2017) noted that British climate change academics, policy makers and practitioners who all worked with climate change found it difficult to imagine what an alternate low energy system would look like in the year 2030. While the fact that individuals have difficulty visualising the future could be perceived as a challenge, it also presents an opportunity for science communicators as this lack of clarity creates a blank, or at least open, slate regarding future low carbon systems.

Story is one way that practitioners can provide individuals with depictions of future travel that encourage low carbon futures. Another major research finding was that reading a short story or textbook intervention helped people envision the year 2050 (Section 6.3.). After reading either the textbook or story intervention a significant number of participants in the Story Survey reported improved ability to visualise the year 2050 (*story* $p < 0.001$, medium size effect, $r = 0.39$; *textbook* $p < 0.001$, medium size effect, $r = 0.40$) (Section 6.3). A significant number of participants also changed their descriptions of travel in the year 2050 to be more consistent with ideas presented in the story and textbook intervention about adopting low carbon travel (Section 6.2.1., Appendix Q). This suggests that providing individuals with a depiction of a low carbon mobility future can help them visualise an alternate, low carbon future. It also supports the idea that participants' initial lack of references to low carbon mobility was due to the fact that they had not considered these options and not to scepticism surrounding the likelihood that society would or could transition to low carbon mobility (Section 6.8.1.). Alternatively, participants may have changed their answers to be text consistent because they believed that was the answer that the researcher wanted (Cook et al., 2012). While less ideal than having changed participants expectations, participants' in this scenario would still have reflected on the idea of low carbon mobility as a possible future.

Story may also be a useful tool for getting people to start thinking about what a future consisting of low carbon mobility systems would look like. In the follow-up interview 18 months after the survey, participants were asked whether reading the texts changed the way they thought about travel. Forty eight percent ($n = 15$) of the 31 participants interviewed said the interventions had got them to think a little differently about travel.

I hadn't ever really paused to think about that far ahead in the future and what it might look like. [Having] said that, you know my area of research has been in environmental impacts and that sort of thing so it's something that on an almost daily basis I am thinking about to some degree. But what I like about that and what I remember most about that is just that, [I] hadn't sort of thought about it in a really futuristic kind of way and how it might actually...well what it might actually look like I suppose. [Female, Australian, 40-49, Story]

Maybe [the intervention has] made me think more about [low carbon travel] because I have thought more about it. So maybe that's just the sign of the times or [the intervention] did spark something. [Male, Australian, 40-49, Story]

It is important for people to start considering low carbon mobility as a possible future now as people can react to issues differently depending on whether they are given time to think about them. Turgeon (2009) found that having individuals with a little bit of topic knowledge take a moment to think about the issue before entering a polling booth increased their likelihood of providing an opinion on the issue. He argued that this was because thought can lead to the formation of attitudes (Turgeon, 2009). Similarly, the Elaboration Likelihood Model attributes thoughtful consideration (i.e. elaboration) to attitude formation and attitude change (Petty & Cacioppo, 1986), and in the Theory of Planned Behaviour an individual's attitudes towards a behaviour is an important predictor of their engagement in that behaviour (Ajzen, 1985). Therefore, having people start to form their attitudes towards low carbon mobility could influence transition. While Turgeon, (2009) found providing a moment to think to participants with no knowledge of the issue made little difference to their likelihood of non-response, story and expository text could be written to contain information about low carbon mobility reducing the chances of individuals being uninformed.

Giving people a moment to think does not always result in positive responses. For individuals who are very knowledgeable about a topic, a moment to think can actually increase non-response rates possibly because they start considering multiple perspectives and questioning their initial opinions (Turgeon, 2009). Providing people with more than 24 hours to think about issues such as groundwater protection (Brouwer, Ordens, Pinto, & de Melo, 2018) and 'next generation' vaccines (Cook, Jeuland, Maskery, & Whittington, 2012) has been shown to decrease people's willingness to pay money to address these issues. Perhaps, this is because the extended timeframe gives people time to work out how they think and feel about the issue. There is no guarantee that after

spending time thinking about low carbon mobility futures individuals would form positive attitudes towards transitioning; however, that does not mean that people should not have the opportunity to spend time thinking about the transition to low carbon mobility systems.

The fact that participants may not have thought about what travel in a low carbon future would be like before participating in the Story Survey could help explain why subtlety appeared to be less important to persuasion than initially predicted. There is literature suggesting that subtle messages are more persuasive because individuals are less likely to notice and scrutinise them (Moyer-Gusé & Nabi, 2010). Since future travel may have been a novel approach to thinking about climate change mitigation for participants, it is possible that their answers were less likely to be prompted by outside influences such as political messaging. As participants spend more time thinking about the issue, and or are exposed to more information about the transition to low carbon mobility, their answers regarding what they expect travel in the year 2050 will look like could change. It may have been more important to have a subtle message had the Story Survey investigated a topic that is often associated with climate change mitigation and publicly debated (eg. the future of energy production).

Stories and texts may also be able to encourage people to think about travel in a new way. For example, in the post-test one participant commented:

Well I never thought about local travel. I have done that most of my life and especially as a child. We never took a vacation that involved long distances, always within a day drive or just staying home. [Female, American, 60+, Textbook]

This is interesting because it encouraged the participant to reflect on her own experiences and, arguably, understanding of travel. One of the interview participants who had a very good recollection of information in the textbook intervention despite over a year having passed attributed it to the fact that “It made me think so that’s why probably I still remember [Female, Japanese, 20-29, Textbook].” Again, this hints at how stories may be able to get people to contemplate on an issue. Even a participant who disagreed with the future outlined in the intervention stated that there may be merit to considering it as a possibility. She stated, “I doubt bicycles will replace cars, but it encouraged some reflection [Female, American, 18-29, Story]”

In a Canadian study of avid readers, when asked why they liked their favourite book one third of participants said it was because the book had helped awaken them to a new perspective or set of possibilities (Ross, 1999). Thinking about mobility systems in a new way could change how people engage with travel. A study investigating why U.K. citizens adopted a low carbon lifestyle found that the most common motivations were not the more traditional environmental incentives but social justice considerations (Howell, 2013). Thus, using stories to expose individuals to alternate mobility systems and alternate viewpoints might change the way they conceptualise travel, which could in turn change their attitudes and behavioural intention towards transitioning to low carbon mobility systems.

Story may be a useful tool for communicating about climate change because it might encourage individuals to reflect and re-evaluate their travel behaviours and roles in the transition to low carbon mobility. In some cases, reading the textbook or story intervention led to self-reflection. These participants took ideas that were presented in the text and examined how these ideas related to their own experiences and personal lives. There are other examples of story inspiring self-reflection. Watching the Hollywood movie *Crash* caused university students to reflect on their own prejudices (Kinefuchi & Orbe, 2008; Tisdell & Thompson, 2006). Similarly, preliminary results from Daniels et al. (2017) suggested that participants reflected on their contribution to climate change after watching an episode from the television documentary show *Years of Living Dangerously*.

Through self-reflection, people may be able to identify behaviours that could be changed (Hunter, Carmichael, & Pangbourne, 2006). By inspiring self-reflection, stories may be able to get people to think critically about how their own travel behaviours contribute to the growing problem of rising emissions and the steps that they, as an individual, should take to help reduce this problem. A Scottish study found that keeping a diary of household purchases made over a two week period alerted participants to the fact that they were not always as environmentally sustainable as they thought (Hunter et al., 2006). Similarly, a program in the U.K. that took pictures of what young adults threw in the rubbish bin and then uploaded these pictures to Facebook found that this process caused self-reflection that may have resulted in participants paying more attention to their waste management practices (Thieme et al., 2012).

van der Linden et al. (2015) recommended that science communicators use stories emphasising relevant personal experiences when communicating about climate change since the human brain has a tendency to prioritise experience over statistic and data analysis. This thesis demonstrates that participants can take messages from stories and consider their personal relevance. Perceived relevance has been linked to how individuals perceive climate change risk (Brody et al., 2008; Hopkins, 2015) and since narrative empathy may enable individuals to ‘live’ other people’s experiences through story (Keen, 2006), by highlighting these experiences with climate change or climate related issues practitioners may engage individuals in new or different experiences that could change the way individuals think about and relate to these issues.

Along with getting people to think about a low carbon mobility future, story may also be a useful tool for starting a discussion. Although the survey did not set out to initiate discussion, some of the responses written by participants could form the starting point for a discussion. This is especially true with comments that disagreed with the information presented in the interventions. For example, one participant commented, “N.Z. will never be able to build a decent bus or train system throughout the whole country but there will not be a need to do so [Male, Chinese, 18-29, Textbook].” It would be interesting to follow-up on what barriers he sees to New Zealand developing public transit systems and why he does not believe that these systems are necessary.

There is evidence to suggest that stories can inspire discussion. Wilbur and Myers (2016) investigated Twitter reactions to the American National Football League (NFL) in the wake of the 2015 Hollywood film *Concussion*. While the study did not focus on the discussion created by the movie; the authors mention that their study ignored response Tweets suggesting that, at least in some cases, certain Tweets discussing the movie sparked a response (Wilbur & Myers, 2016). Additionally, the authors noted that some of the Tweets contained links including those to news articles and blog post (Wilbur & Myers, 2016), again indicating that the movie *Concussion* created discussion and contributed to the debate surrounding contact sports. *Entertainment education* which intentionally embeds educational messages within entertainment has found stories in television shows or radio programs to be effective at starting conversations within families including family planning (Rogers et al., 1999; Sharan & Valente, 2002; Valente, Kim, Lettenmaier, Glass, & Dibba, 1994), HIV/AIDS (Chatterjee, Bhanot, Frank,

Murphy, & Power, 2009), breast cancer (Wilkin et al., 2007), gender equality, women's rights and antidowry (Papa et al., 2000).

It would also be fascinating to see what would happen in a conversation between two participants with opposing ideas of future travel. For example, imagine sitting the Chinese participant quoted above down with the participant who stated...

I think inner cities will use more bikes and public transport to minimise traffic congestion. Public transport will be fuelled by clean, sustainable energy not polluting fossil fuels. Inter-city transport will be by electric cars or high-speed, low-polluting options like the Hyper-loop. For across ocean travel, I assume we'll have sorted out cleaner alternatives to our current air transport. [Female, New Zealander, 40-49, Story]

Although these two participants have different expectations for future travel, it would be interesting to see if they also have expectations that overlap and if their opinions would change as the discussion progressed. It would also be useful to see if participants felt any benefits from discussing their perceptions of future travel with individuals who hold different perspectives. Future studies could use focus groups to follow-up on this line of inquiry.

There is evidence suggesting that discussion can lead to an increased understanding of an issue. In education, discussion based approaches to teaching have been correlated with higher middle school and high school test scores (Applebee, Langer, Nystrand, & Gamoran, 2003). Tisdell and Thompson (2006) describe how graduate students in an adult education department increased their understanding of the factors contributing to the Rwandan genocide through an online discussion of the movie *Hotel Rwanda*. Peer discussion in an undergraduate genetics class increased the likelihood of students choosing the correct answer on a quiz (Smith et al., 2009). Interestingly, this last study found that it was unnecessary for any of the students in the group to know the correct answer to the question, but that through discussion students could collectively reason the answer out (Smith et al., 2009). Higher education has also used debates and online discussions to facilitate critical thinking (e.g. Camp & Schnader, 2010; Richardson & Ice, 2010). Therefore, through discussing the depiction of a low carbon future in a story, individuals may be able to draw on and elaborate their own understandings of climate change, mobility systems, barriers and opportunities surrounding the transition to low carbon mobility.

In terms of whether discussion can change an individuals' opinion, results from an Indian study suggested that discussion can influence opinions as it found interpersonal communication helped explain participants' attitudes regarding HIV following the broadcast of an Indian television show (Chatterjee et al., 2009). A Finnish study reported that participating in deliberative discussion was able to change people's opinions on nuclear power, but the authors noted that this change tended to involve individuals shifting their opinions towards the middle, pointing out that this is not always a useful change (Himmelroos & Christensen, 2014). When developing the interventions, it was understood that the future scenarios being described were idealistic and as one participant noted, involved wearing "some very rose coloured goggles in terms of the environment and [people's] desire to help it. [Male, Canadian, 18-29, Story]." This was intentional. However, in their responses to the interventions some participants raised some valid criticisms of the scenarios presented in the texts. For example, "The elderly will not likely be able to physically bicycle an awful lot [Female, Canadian, 60+, Textbook]." The scenarios were designed based on the literature (Chapter Three) but were written by a young adult who, based on her own life experience, did not consider mobility issues that could prevent others from cycling. However, reading that comment helped her understand why not everyone would believe that there will be more cycling in the future. While this was not a proper discussion it highlights how a discussion between people with different opinions and life experiences can facilitate understanding.

Transitioning to low carbon mobility will require collective action. One of the challenges with this is that people with contrasting worldviews react differently to the concept of climate change (Kahan et al., 2012). Therefore, having a better understanding of other people's opinions surrounding low carbon mobility may help people work together to bring about the transition. Dialogue has been shown to facilitate understanding between individuals from diverse cultural backgrounds (DeTurk, 2006). Individuals were also more likely to be able to give reasons why others might disagree with their own political opinions if they discuss politics with people who hold differing political opinions (Price, Cappella, & Nir, 2002). This suggests that having discussions with dissimilar people may increase a individuals' understanding of others. It has been shown that individuals are more likely to encounter people with different political opinions than themselves on forums that are not related to politics (example hobby, interests, trivial, sport, socialising, movies, tv) (Wojcieszak & Mutz, 2009). As such, stories where low

carbon mobility is discussed but not the main point of the story may be able to draw in people of different opinions and provide a reason to start a conversation. Through this conversation, participants may be able to increase their understanding of others.

Lastly, discussion may also be important for facilitating behavioural and societal change. For example, a study of 12 050 Indians who watched a weekly crime drama aimed at increasing HIV/AIDS knowledge found interpersonal discussions with a spouse increased an individual's likelihood of engaging in HIV preventative behaviours (Chatterjee et al., 2009). Singhal and Vasanti (2005) suggested that story through mediums like Bollywood films can help make topics like HIV/AIDS less taboo and that this is important because social change cannot occur if people are unwilling to address the issue. Similarly, researchers investigating the impact of a radio soap opera on social change in an Indian village noted that discussions allowed for an environment where social change could occur, even if realising that change remained complicated (Papa et al., 2000). Low carbon mobility requires social change. Creating opportunities for people to discuss and debate the idea of a low carbon mobility future might make it easier or at least quicker to realise this future.

7.4.2. Challenges to using story as a tool for communicating

For story to be used most effectively, science communicators need to be aware of its limitations. While the story intervention was able to change participants' expectations of future travel, it was less effective than the expository textbook intervention (Section 6.2.). As discussed in Section 6.2.1.1. this could be due to an unequal use of causality between texts rather than a characteristic of story itself. Additionally, a greater percentage of participants who read the textbook version agreed that the world depicted in it was realistic compared to those who read the story; this is important as those who perceived the text to be more realistic were less likely to contradict the text (Section 6.4.). These findings contribute to the ongoing discussion surrounding the factors that influence persuasion, particularly narrative persuasion. The results from the Story Survey encourage the idea that causality should be explored in both narrative (Dahlstrom, 2010, 2012) and non-narrative persuasion. The results also highlight the difficulty of identifying what aspects of a text contribute to its persuasiveness and that it can be difficult to construct comparative texts of different styles. This makes it difficult to definitively state that one format (for example story) is the most effective method of conveying a message.

One of the biggest challenges for climate change communications is that although story could be a useful tool for stimulating discussion these discussions could extend the controversy surrounding climate change. Using stories to foster climate change conversations could give sceptics a platform to spread misinformation. A content analysis of climate change/global warming tweets from 2012 found a correlation between the number of climate change articles published in major newspapers and the number of weekly tweets about climate change (Kirilenko & Stepchenkova, 2014). This suggests that these media reports provided stimulus for public discussion. The same study also reported that while individuals were more likely to reference traditional media sources such as *The Guardian* or the *Washington Post*, the second and third most referenced blogs belonged to climate sceptics (Kirilenko & Stepchenkova, 2014). Similarly, two of the most discussed events of that year on Twitter were articles published in the *Daily Mail* denying climate change (Kirilenko & Stepchenkova, 2014).

This is important because the orchestrated increase in visibility of climate change sceptics in the late 1990s promoted the incorrect notion that climate change is not a problem, changing the national conversation and contributing to climate policy inaction in the United States (Boykoff & Boykoff, 2007; McCright & Dunlap, 2003; Oreskes & Conway, 2010). The journalistic norm of providing balanced coverage in the media created the appearance that climate change was a fiercely debated and contentious issue within the scientific community (Boykoff & Boykoff, 2007) when the reality was that the overwhelming consensus in the literature was that climate change was occurring (Oreskes, 2004). The mainstream media, like the L.A. Times, started moving away from giving climate change sceptics a voice (Elliot, 2013), but practitioners should be aware that using stories to stimulate national and international discussions on climate change could also give climate change sceptics a platform to continue arguing that climate change is a non-issue. It may be possible to use stories to inspire discussions around alternative low carbon futures without setting off climate change sceptics if the stories promote visions of low carbon mobility or other low carbon lifestyles without referring to climate change as this might decrease the opportunity for sceptics to engage with the topic. Further research should examine whether decreasing the association between low carbon futures and climate change could make people feel even less urgency to transition to low carbon systems.

7.5. Thinking about low carbon mobility

This thesis discussed the urgent need to transition to low carbon mobility in order to reduce global emissions and mitigate climate change. It is useful to contemplate what, if anything, can be deduced from this thesis regarding whether or not this transition is underway. These studies were not designed to assess the transition to low carbon mobility systems; therefore, discussion in this section is speculative.

The first challenge is identifying a framework to help conceptualise the transitioning to low carbon mobility. While the IMSC (Longnecker, 2016) is a useful framework for thinking about how individuals respond to new information it does not identify how likely an individual is to transition to low carbon mobility. Similarly, the Theory of Planned Behaviour (TPB; Ajzen, 1985) is a useful framework for understanding why an individual may or may not engage in a particular behaviour, but it provides a dichotic answer regarding an individuals' likelihood of changing their behaviour whereas transitioning may be more of a fluid process. The Transtheoretical Model of Behaviour Change (TTM also known as the Cycle of Change model) provides a framework for identifying an individual's trajectory along their pathway of change (Prochaska & Goldstein, 1991; Prochaska & Velicer, 1997). The TTM model states that individuals proceed through the following five to six stages: pre-contemplation, contemplation, preparation, action, maintained and (ideally not) relapse (Prochaska & Velicer, 1997). The TTM has been applied to low carbon mobility behaviours (e.g. McKee, Mutrie, Crawford, & Green, 2007; Molina-García, Castillo, Queral, & Sallis, 2013; Rissel et al., 2010). However, a literature review by Friman, Huck, and Olsson (2017) highlighted an apparent disregard for designing and applying stage appropriate interventions—a missed opportunity since theory is an important tool when designing communication interventions (Harrison, 2014).

There have been concerns with the TTM as a behavioural change model (West, 2005). One concern is that the boundaries between the stages are arbitrary (Etter & Sutton, 2002; West, 2005). The criticism that people can progress through the stages even when they do not participate in an intervention (West, 2005) is only applicable to intervention evaluations and less relevant when using the TTM to identify transition stage. However, the observation that the stages are not unidirectional and individuals can move both backwards and forwards through stages (De Nooijer, Van Assema, De Vet, & Brug, 2005) is important because it changes the assumptions about how people progress through the

stages and what can happen after reaching the next stage. Another relevant criticism is that the TTM assumes decisions are made logically (West, 2005) which — as discussed in Section 1.2. — ignores many of the factors which influence decision making.

Rogers' (2010) Diffusion of Innovation Model was developed to explain the adoption of innovations in a population. However, it may also provide a useful framework for thinking about the adoption of *ideas* in a population—specifically the idea of a low carbon mobility future. For the purpose of this discussion, it is assumed that mentioning low carbon mobility in their description of travel in the year 2050 means that a participant has adopted the idea that future travel will transition to low carbon mobility. The Diffusion of Innovation model breaks adopters into five categories based on the relative time it takes for them to adopt the innovation: innovators, early adopters, early majority, late majority and laggards (Rogers, 2010). This thesis found that 28% of participants in the Temporal Distance Survey and 43% of participants in the Story Survey discussed low carbon mobility. Based on the timeline of probability distributions outlined in the Diffusion of Innovation model the idea that the future will transition to low carbon mobility has been accepted by adopters in the early majority (Figure 7.3). *If* the results from the Temporal Distance Survey are reflective of those of the broader American public before the Presidential election in 2016 these results would suggest that the idea of low carbon mobility had started to become mainstream at that time. However, just because individuals were thinking about low carbon mobility does not mean they were prepared to *act* on these thoughts.

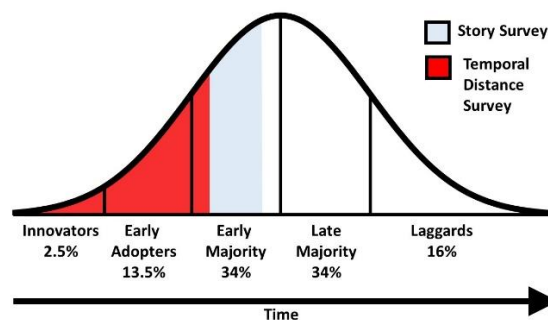


Figure 7.3: Diffusion of the idea of a low carbon mobility future amongst survey participants (adapted from Roger, 2010)

7.6. Moving towards a more sustainable mobility future

Transition management argues that the transition to low carbon mobility requires pushing changes on three levels: the individual, the cultural and the structural (Kemp et al., 2011; Kemp et al., 2007; Loorbach, 2010; Rotmans et al., 2001). The IMSC (Longnecker, 2016), TTM (Prochaska & Goldstein, 1991) and TPB (Ajzen, 1985) explain change at the individual level and as such may be useful tools for promoting change at the individual level. For example, Bartholomew, Parcel, Kok, Gottlieb, and Fernández (2011) suggested that getting people to re-evaluate the outcomes and benefits of engaging in a behaviour is one way to move them from precontemplation (not thinking about changing behaviours) to the contemplation stage (seriously considering changing behaviours in the near future) of the TTM (Prochaska & Goldstein, 1991; Prochaska & Velicer, 1997). Similarly, the IMSC and TPB posit that changing an individual's attitudes about a behaviour will influence their willingness to engage in that behaviour (Ajzen, 1991; Longnecker, 2016). This would suggest that focus should be given to changing participants' perceptions regarding the outcomes and benefits of transitioning to low carbon mobility. This thesis found that story was a useful tool for helping participants visualise what low carbon mobility futures could look like. Having stories depict future low carbon mobility systems may help bring about a re-evaluation of the perceived benefits and drawbacks of this system.

Changes at the structural level of transport systems such as the creation of supporting infrastructure or policies could also influence people's perceptions of the benefits and disadvantages of engaging in low carbon mobility. Both the TPB and IMSC acknowledge that environmental support and perceived control influence the decision making process (Ajzen, 1985; Longnecker, 2016). For, example increasing cycle infrastructure has been correlated to an increased number of individuals commuting to work (Dill & Carr, 2003; Pucher, Buehler, & Seinen, 2011). A common expectation of travel in 2050, in responses to the two 2016 surveys was that more or all vehicles would be electric. Yet, mainstream consumers in the U.K. were unwilling to adopt the technology after a week of trialling a current-generation (2010) electric car because they said they felt that these electric vehicles and the supporting infrastructures were still a 'work in progress' (Graham-Rowe et al., 2012). Increased infrastructure would reduce 'range anxiety'—one of the concerns reported by participants in that study. Participants' descriptions of travel in 2050 also revealed the importance of transport being convenient,

fast and cheap (Chapter Four). If structural changes were implemented to make low carbon travel more convenient, faster and cheaper individuals may re-evaluate the benefits and disadvantages of low carbon mobility.

Social norms have also been identified as a way to encourage behaviour change (Bartholomew et al., 2011; Longnecker, 2016). Section 1.4.3. raised the idea that story might influence social norms by promoting the narrative that society engages in and values low carbon lifestyles. Industry may also play a role in promoting low carbon behaviours as industry feedback can change individual behaviours regarding electricity consumption (Schultz et al., 2007) and towel washing behaviours (Goldstein et al., 2008). Social norms also work at a cultural level as they are a reflection of culture. International treaties such as the 2015 Paris Agreement provide social cues as to what the global society believes are important values. Rallies and petitions provide similar cues on a smaller scale. Lastly, structural cues like bike and bus lanes or electric charging stations could also reinforce the idea that low carbon mobility is normal. There are many countries including Japan (McCurry, 2016), New Zealand (<https://charge.net.nz>), and Canada (Mehta, 2016) which are increasing their network of public electric vehicle charging stations. Norway is aiming to be petrol free by 2025 (Chrisafis & Vaughan, 2017; Eisenstein, 2017). This commitment to creating low carbon infrastructure suggests that these countries recognise that low carbon mobility is becoming more mainstream and are providing the infrastructure necessary for this transition to happen.

7.7. The need for continued cross-disciplinary collaboration

One of the goals of interdisciplinary research is to solve complex problems that cannot be solved by researchers a single discipline (Porter & Rafols, 2009). The problem of climate change is wicked (Head, 2008; Rittel & Webber, 1973) or even super wicked (Levin, Cashore, Bernstein, & Auld, 2007). Table 7.1 lists the ten key features of a wicked problem as identified by Rittel and Webber (1973) as well as the additional four key factors that turn a wicked problem into a super wicked problem (Levin et al., 2007). The fact that wicked problems are symptoms and thus inherently linked to other issues means that they can be interdisciplinary in nature. Climate change is a scientific phenomenon caused by human behaviour, and as such, solutions to climate change require an integrated knowledge of the natural, and social sciences (Holm et al., 2013). Additionally, transition to low carbon mobility systems will require an understanding of multiple disciplines. This

thesis addressed this by incorporating knowledge from a variety of fields including: science communication, risk communication, transportation, tourism, and psychology.

Table 7.1: Key factors of wicked and super wicked problems as identified by Rittel and Webber (1973) and Levin et al. (2007)

Problem	Key Factors	Source
Wicked problems	<ul style="list-style-type: none"> • There is no definitive formulation of a wicked problem. • Wicked problems have no “stopping rule” (i.e., no definitive solution). • Solutions to wicked problems are not true or false, but good or bad. • There is no immediate and no ultimate test of a solution to a wicked problem. • Every (attempted) solution to a wicked problem is a “one-shot operation”; the results cannot be readily undone, and there is no opportunity to learn by trial and error. • Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan. • Every wicked problem is essentially unique. • Every wicked problem can be considered to be a symptom of another problem. • The existence of a discrepancy representing a wicked problem can be explained in numerous ways. • The planner has no “right to be wrong” (i.e., there is no public tolerance of experiments that fail). 	<p><i>Quoted from:</i> (Brian W. Head & Alford, 2015, p. 714)</p> <p><i>Originally presented in:</i> (Rittel & Webber, 1973)</p>
Super wicked problems	<ul style="list-style-type: none"> • Time is running out, • Those who cause the problem also seek to provide a solution, • The central authority needed to address them is weak or non-existent, and • Irrational discounting occurs that pushes responses into the future. 	(Levin et al., 2007, p. 124)

There is a strong argument to be made for the continued and increased collaboration between science communication researchers and those studying transport and tourism when it comes to facilitating the transition to low carbon mobility. Sharing the specialised knowledge generated by these different disciplines can provide a more holistic understanding of the issue. For example, transport and tourism researchers can provide their expertise regarding the state of travel technology (e.g. Nunes, Figueiredo, & Brito, 2016; Peeters et al., 2016), travel behaviours (e.g. Hares et al., 2010; Juvan & Dolnicar, 2016; Luo, Becken, & Zhong, 2018), motivations (e.g. Kozak, 2002; Ooi & Laing, 2010), perceived barriers (e.g. Cohen, Higham, & Reis, 2013; Farla, Alkemade, &

Suurs, 2010), and stakeholders (e.g. Timur & Getz, 2009). Science communication researchers may have more experience with creating environmental behaviour change interventions (e.g. Schultz et al., 2007; Tijs et al., 2017), message framing (e.g. Benjamin, Por, & Budescu, 2017; Hart, 2011; Newman, Howlett, Burton, Kozup, & Heintz Tangari, 2012), and confronting misinformation (e.g. McCright & Dunlap, 2017; Shelby & Ernst, 2013). The partnership prevents wasting precious time ‘reinventing the wheel’ and replicating knowledge that already exists or falling into known pitfalls. Considering the time sensitive nature of mitigating climate change, this is vital. Communication between science communicators and transport and tourism practitioners could lead to the coordination of complementary campaigns and interventions. This reinforcement might increase the likelihood of transition as reinforcement has been associated with behaviour change (Heimlich & Ardoin, 2008). Additionally, discussions throughout this thesis have highlighted the idea that transitioning to low carbon mobility requires simultaneously targeting multiple actors on multiple levels and this might be more realistically achieved by having several coordinated drivers.

7.8. Lessons Learnt

One of the limitations of the Story Survey was that it attempted to measure changes in participants’ levels of concern about climate change in a cohort of individuals already reporting high levels of concern about climate change. In hindsight, there are two main modifications to the Story Survey that would have improved the study. First, the sampling method targeted individuals who were likely to be concerned about climate change. For example, in order to increase the low response rate invitations were sent to mailing lists, including science communication mailing lists. While the insight gleaned from this concerned cohort was useful for answering many of this thesis’ research questions, it was not an appropriate cohort for measuring the impact of the interventions on climate change risk perceptions. This was why a different sampling method was used in the Temporal Distance Survey since it also investigated climate change risk perceptions.

Second, the Story Survey set out to investigate the influence of two interventions on a variety of different factors including participants’ ability to visualise the future, expectations of future travel, and climate change risk perceptions. Instead of attempting to explore all these factors, it might have been better for the Story Survey to limit its

scope. The influence of story on climate change risk perceptions could have been removed from the Story Survey and explored in a separate, follow-up or parallel study. Researchers wanting to repeat or build on the Story Survey should consider designing the story to try and elicit change in one, targeted aspect instead of using one story intervention to attempt to change a number of attitudes and opinions.

7.9. Directions for future research

The results and discussions presented in this thesis raise a number of interesting questions that warrant further exploration. First, after determining that temporal distance was an inadequate framework for understanding climate change risk perceptions, an alternate cognitive dissonance model was proposed as a way to explain individuals' perceptions of climate change risk (Section 7.2.1.). Since testing this model was beyond the scope of this thesis, future research should empirically test the proposed cognitive dissonance model. As mentioned in Section 7.2.1., a number of the questions used to segment the American public in the Six Americas study could be adapted to test this model (Maibach et al. 2009).

Second, this thesis found that the textbook styled expository text was more effective at changing expectations than a short story, but it acknowledges that the textbook version had a clearer explanation of how the low carbon mobility future came about whereas the story version just dropped readers into the future low carbon world without any explanation of how or why the transition occurred. Research by Dahlstrom (2010; 2012) suggested that causality is a driving component of narrative persuasion. It may be that perceived causality is not only important in narrative persuasion but persuasion in general. The famous Heider and Simmel (1944) experiment showed that people automatically attribute motivations (i.e. causes) to the movement of shapes in a short film (see also Bloom & Veres, 1999). Causality may be central to the way people understand the world. One way to modify the Story Survey to test for causality would be to rewrite the story intervention to include the same cause and effect explanations that were present in the textbook intervention. A separate study could also compare two versions of the textbook intervention, one with the causality of transitioning to low carbon mobility explicitly expressed and one without these clear connections to see if causality plays a similar persuasive role in expository texts as it does in narratives. Determining the role that perceived causality plays in persuasion is important as it can help inform the design of more successful low carbon mobility interventions.

Providing a clear depiction of cause and effect relationships may also help individuals understand and accept the process of bringing about low carbon mobility. Veland et al. (2018) nominated story as a tool for getting people to visualise the process of transitioning to low carbon futures. This thesis found that story and expository text were useful tools to help participants visualise low carbon futures, but it did not explore whether they were effective devices for helping visualise the transition process. There is evidence to suggest that stories that model a desired behaviour resonate with avid readers (Ross, 1999), so it is possible that people internalise pathways presented in story. It is worth following up on the Veland et al. (2018) suggestion with research investigating how stories outlining a transition pathway can influence an individual's mobility behaviour.

Third, when exploring the influence of story, this thesis used written story and text interventions; however, there are many other media that could be used to tell a story (e.g. movies, social media such as Instagram and SnapChat). It is likely that different audiences may be attracted to different types of story media. For example, a study from the United States found a decreasing trend in the number of high school students who read one or two books a year for fun (Twenge, Martin, & Spitzberg, 2018). Instead, these students are spending more time online (Twenge et al., 2018). Therefore, if science communicators want to target younger audience they may want to consider exploring how they could utilise social media (for example, Instagram's stories feature). Interestingly, in 2015 Forbes reported that four of the top sixteen highest grossing authors wrote for young adults (Robehmed, 2015), but their main consumers might actually be a broader audience of people ages 18-44 (New York, 2013). Again, this suggests that additional research may be more appropriate for different audiences. A study comparing individual immersion in a written story versus a story on film found that need for cognition dictated medium preference (Green et al., 2008). The effectiveness of a written story will likely vary based on personal preferences. Future research could investigate the effectiveness of using different types of media to reach and persuade different audiences.

Fourth, related to the previous idea of exploring the influence of story in media beyond the written word, it would be interesting to see the impact of watching the 2017 Hollywood climate change disaster movie *Geostorm*. A few studies have been conducted on how story can influence climate change risk perceptions following the release of the 2004 Hollywood climate change disaster movie *The Day After Tomorrow* (Leiserowitz,

2004; Lowe et al., 2006). These studies reported the movie caused a short-term increase in climate change risk perception (Leiserowitz, 2004; Lowe et al., 2006). While *The Day After Tomorrow* depicted large scale death and destruction due to climate change induced severe weather, the plot of *Geostorm* revolved around having solved climate change through a system of satellite technology and then having this technology malfunction, leading to extreme weather conditions and many deaths (Devlin, 2017). In this thesis, participants placed a lot of hope in future technologies to mitigate climate change (Chapter Three and Four). It would be intriguing to see how *Geostorm*'s portrayal of a technological solution to climate change influences perceptions of climate change risk, their technological optimism as well as their willingness to participate in climate change mitigation solutions.

Fifth, it would be interesting to investigate how story could use narrative empathy (Hsu et al., 2014; Keen, 2006) and identification with characters (Green & Brock, 2000; Moyer-Gusé & Nabi, 2010; Sestir & Green, 2010; Vezzali et al., 2015) to inspire empathy and identification with victims of climate change and how this, in turn, could influence people's perception of climate change risk. Identity was one of the predictors nominated within this alternative framework (Figure 7.2) providing additional support for further investigation into identification with story characters. Identity has been named as a construct that could help move individuals from contemplating transitioning to low carbon mobility to preparing or changing their mobility behaviours (Friman et al., 2017).

Lastly, this thesis focused on the impact that reading a short story had on an individual. It would be interesting to see the effects of asking individuals to write or create their own stories. For example, individuals could be asked to write a story about themselves in a low carbon future. Alternatively, individuals could be given information and asked to create a fictional story set in a low carbon world. It may be more beneficial in terms of promoting behaviour change to involve individuals in the creation of alternate future scenarios. Creativity has an integral role in thinking about and resolving issues of sustainability (Mitchell & Walinga, 2017; Stucker & Bozuwa, 2012). Engaging people in exercises where they are creating future scenarios could encourage creativity which may lead to different ways of think about current systems and sustainability. After having participants imagine their ideal future it might be important to get them to think about current barriers that could prevent that future from being realised and brainstorm ways to overcome these obstacles.

A game inviting participants to create a utopian low carbon energy in London did this by having players challenge the other teams' ideas by creating a 'narrative of consequences' (Smith et al., 2017 p.288). Teams then refine their ideas as they problem-solve their way through the issue (Smith et al., 2017). There is tentative evidence suggesting that people are more likely to set goals to realise their desired future if they have also considered the current barriers and believe that there is a high likelihood of success (Oettingen, 2000; Oettingen, Mayer, Thorpe, Janetzke, & Lorenz, 2005). While this could backfire if the goals are perceived to be unattainable, it would still be interesting to see how individuals try and problem-solve their way through the issues surrounding the transition to low carbon mobility.

7.10. Conclusion

Climate change continues to pose a serious threat which will worsen unless societies rapidly transition to lower carbon lifestyles (IPCC, 2014). People's attitudes towards the future and ability to visualise the distance future may not significantly influence the way they perceive climate change risk. However, as levels of concern about climate change continue to intensify science communicators should focus less on convincing people that climate is a serious problem and more on engaging people in climate change mitigating solutions. While people are becoming increasingly concerned about climate change, it appears that low carbon options are not top of mind when people picture future travel. This is unfortunate because travel emissions must be reduced in order to meet mitigation targets. Science communicators should bridge this gap with story as an increasingly well understood tool that can be deployed to help people envision low carbon futures, get people thinking about low carbon mobility and start discussion. It may also be important to feature current technology in portrayals of alternative futures as hope in future technology could result in continued delays in the adoption of low carbon mobility systems. Climate, travel and story will continue to be an important and integral part of human life and the intersection between the three may yet prove to be significant in the pathway to a suitable, climate neutral, low carbon transportation future.

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Appendix A

Story Survey

Using Stories to Make Sense of our Changing World

Consent

1) By selecting "Yes" I agree to the following:

i) That I am over the age of 18

ii) That I have read and understand the [information and consent sheet](#) associated with this project

iii) I am willing to participate in this project*

☐ Yes

☐ No

Demographics

2) I am:

☐ 18-19

☐ 20-24

☐ 25-29

☐ 30-34

☐ 35-39

☐ 40-49

☐ 50-59

☐ 60+

3) I am:

☐ Male

☐ Female

☐ Other

☐ I'd rather not say

4) I am (*nationality*):

- | | | | |
|-------------------------------------|---------------------------|--------------------------|---------------|
| ○ Afghanistan | ○ Albania | ○ Algeria | ○ Andorra |
| ○ Angola | ○ Antigua and Barbuda | ○ Argentina | ○ Armenia |
| ○ Australia | ○ Austria | ○ Azerbaijan | ○ Bahamas |
| ○ Bahrain | ○ Bangladesh | ○ Barbados | ○ Belarus |
| ○ Belgium | ○ Belize | ○ Benin | ○ Bhutan |
| ○ Bolivia | ○ Bosnia and Herzegovina | ○ Botswana | ○ Brazil |
| ○ Brunei | ○ Bulgaria | ○ Burkina Faso | ○ Burundi |
| ○ Cambodia | ○ Cameroon | ○ Canada | ○ Cape Verde |
| ○ Central African Republic | | ○ Chad | ○ Chile |
| ○ China | ○ Colombia | ○ Comoros | |
| ○ Congo, Democratic Republic of the | | ○ Congo, Republic of the | |
| ○ Costa Rica | ○ Cote d'Ivoire | ○ Croatia | ○ Cuba |
| ○ Curacao | ○ Cyprus | ○ Czech Republic | ○ Denmark |
| ○ Djibouti | ○ Dominica | ○ Dominican Republic | |
| ○ East Timor (see Timor-Leste) | | ○ Ecuador | ○ Egypt |
| ○ El Salvador | ○ Equatorial Guinea | ○ Eritrea | ○ Estonia |
| ○ Ethiopia | ○ Fiji | ○ Finland | ○ France |
| ○ Gabon | ○ Gambia, The | ○ Georgia | ○ Germany |
| ○ Ghana | ○ Greece | ○ Grenada | ○ Guatemala |
| ○ Guinea | ○ Guinea-Bissau | ○ Guyana | ○ Haiti |
| ○ Holy See | ○ Honduras | ○ Hong Kong | ○ Hungary |
| ○ Iceland | ○ India | ○ Indonesia | ○ Iran |
| ○ Iraq | ○ Ireland | ○ Israel | ○ Italy |
| ○ Jamaica | ○ Japan | ○ Jordan | ○ Kazakhstan |
| ○ Kenya | ○ Kiribati | ○ Kosovo | ○ Kuwait |
| ○ Kyrgyzstan | ○ Laos | ○ Latvia | ○ Lebanon |
| ○ Lesotho | ○ Liberia | ○ Libya | |
| ○ Liechtenstein | ○ Lithuania | ○ Luxembourg | ○ Macau |
| ○ Macedonia | ○ Madagascar | ○ Malawi | ○ Malaysia |
| ○ Maldives | ○ Mali | ○ Malta | |
| ○ Marshall Islands | ○ Mauritania | ○ Mauritius | ○ Mexico |
| ○ Micronesia | ○ Moldova | ○ Monaco | ○ Mongolia |
| ○ Montenegro | ○ Morocco | ○ Mozambique | ○ Myanmar |
| ○ Namibia | ○ Nauru | ○ Nepal | ○ Netherlands |
| ○ Netherlands Antilles | ○ New Zealand | ○ Niger | ○ Nigeria |
| ○ North Korea | ○ Norway | ○ Oman | ○ Pakistan |
| ○ Palau | ○ Palestinian Territories | ○ Panama | |
| ○ Papua New Guinea | ○ Paraguay | ○ Peru | ○ Philippines |
| ○ Poland | ○ Portugal | ○ Qatar | ○ Romania |
| ○ Russia | ○ Rwanda | ○ Saint Kitts and Nevis | ○ Saint Lucia |
| ○ Saint Vincent and the Grenadines | | ○ Samoa | ○ San Marino |
| ○ Sao Tome and Principe | | ○ Saudi Arabia | ○ Senegal |
| ○ Serbia | ○ Seychelles | ○ Sierra Leone | ○ Singapore |
| ○ Slovakia | ○ Slovenia | ○ Solomon Islands | ○ Somalia |
| ○ South Africa | ○ South Korea | ○ South Sudan | ○ Spain |
| ○ Sri Lanka | ○ Sudan | ○ Suriname | ○ Swaziland |
| ○ Sweden | ○ Switzerland | ○ Syria | ○ Taiwan |
| ○ Tajikistan | ○ Tanzania | ○ Thailand | ○ Timor-Leste |
| ○ Togo | ○ Trinidad and Tobago | ○ Tunisia | ○ Turkey |
| ○ Turkmenistan | ○ Tuvalu | ○ Uganda | ○ Ukraine |

- ☐ United Arab Emirates ☐ United Kingdom ☐ United States ☐ Uruguay
- ☐ Uzbekistan ☐ Vanuatu ☐ Venezuela ☐ Vietnam
- ☐ Yemen ☐ Zambia ☐ Zimbabwe

5) The highest level of education that I have completed is:

- ☐ NCEA or School Certification (NZ)/ High School Diploma
- ☐ Polytech/ TAFE/ Community College
- ☐ Undergraduate (non-honours)
- ☐ Honours/ Undergraduate (honours)
- ☐ Postgraduate Diploma/ Postgraduate Certificate
- ☐ Master's Degree
- ☐ PhD
- ☐ Apprenticeship
- ☐ Other - Write In: _____

The Future

6) How clearly can you imagine the future for the following time frames?

	Not At All Clear	Not Very Clearly	Somewhat Clearly	Very Clearly
1 Year	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1-2 Years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5-10 Years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10-20 Years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20-50 Years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
50-100 Years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7) How clearly can you imagine the year 2050?

- ☐ Not At All Clear
- ☐ Not Very Clearly
- ☐ Somewhat Clearly
- ☐ Very Clearly

Travelling in 2050

Imagine it is the year 2050.

8) Do you think travelling in 2050 will be any different than travelling now?

- ☐ Yes
- ☐ No
- ☐ I Don't Know

9) Briefly describe what you think travelling will be like in 2050.

Risk

10) Rank the following global issues in order of concern (*with 1 representing the issue you are most worried about*):

- _____ AIDS
- _____ Radioactive Waste
- _____ Loss of Biodiversity
- _____ Genetic Modification
- _____ Climate Change
- _____ Nuclear Power
- _____ Terrorism

11) I am:

- ☐ Very concerned about climate change
 - ☐ Somewhat concerned about climate change
 - ☐ Not too concerned about climate change
 - ☐ Not at all concerned about climate change
-

Climate Change and Future Travelling

12) Do you think climate change will affect travel plans in 2050?

- ☐ Yes
- ☐ No
- ☐ I don't know

13) How do you think climate change will affect travel plans in 2050?

14) Do you think climate change would affect your lifestyle in 2050?

- ☐ Yes
- ☐ No
- ☐ I don't know

15) How do you think climate change would affect your lifestyle in 2050?

Intervention

Story Intervention - see Appendix B

or

Textbook Intervention - see Appendix C

Thoughts on narrative

16) I enjoyed the text

- | | | | | |
|--|--------------------------------|---|-----------------------------|---|
| <input type="radio"/> Strongly
Disagree | <input type="radio"/> Disagree | <input type="radio"/> Neither Agree
nor Disagree | <input type="radio"/> Agree | <input type="radio"/> Strongly
Agree |
|--|--------------------------------|---|-----------------------------|---|

17) I think the world of 2050 portrayed in the text was realistic

- | | | | | | |
|--|--------------------------------|---|-----------------------------|---|---------------------------------------|
| <input type="radio"/> Strongly
Disagree | <input type="radio"/> Disagree | <input type="radio"/> Neither Agree
nor Disagree | <input type="radio"/> Agree | <input type="radio"/> Strongly
Agree | <input type="radio"/> I don't
know |
|--|--------------------------------|---|-----------------------------|---|---------------------------------------|
-

Travelling in 2050

Some of these questions are repeated intentionally. Sorry if it's annoying, but please answer them again. Thank you!

Imagine it is the year 2050.

18) How clearly can you imagine the year 2050?

- ☐ Not At All Clear
- ☐ Not Very Clearly
- ☐ Somewhat Clearly
- ☐ Very Clearly

19) Do you think travelling in 2050 will be any different than travelling now?

- ☐ Yes
- ☐ No
- ☐ I Don't Know

20) Briefly describe what you think travelling will be like in 2050.

Risk

Some of these questions are repeated intentionally. Sorry if it's annoying, but please answer them again. Thank you!

21) Rank the following global issues in order of concern (*with 1 representing the issue you are most worried about*):

- _____ AIDS
- _____ Radioactive Waste
- _____ Loss of Biodiversity
- _____ Genetic Modification
- _____ Climate Change
- _____ Nuclear Power
- _____ Terrorism

22) I am:

- ☐ Very concerned about climate change
- ☐ Somewhat concerned about climate change
- ☐ Not too concerned about climate change
- ☐ Not at all concerned about climate change

Climate Change and Lifestyles

Some of these questions are repeated intentionally. Sorry if it's annoying, but please answer them again. Thank you!

23) Do you think climate change will affect travel plans in 2050

- ☐ Yes
- ☐ No
- ☐ I don't know

24) How do you think climate change will affect travel plans in 2050?

25) Do you think climate change would affect your lifestyle in 2050?

- ☐ Yes
- ☐ No
- ☐ I don't know

26) How do you think climate change would affect your lifestyle in 2050?

27) I would be interested in participating in a follow up interview

- ☐ Yes
- ☐ No

28) I would like to be entered into the draw to win a \$100US Amazon gift certificate.
(Store can be negotiated upon winning).

- ☐ Yes
- ☐ No

29) Please provide the email address that you would like to be contacted at

30) If you have any other comments please provide them here.

Thank You!

Thank you for taking our survey. Your response is very important to us.

Appendix B

Story Intervention

Please read the following:

New Zealand, November 2050

I was jolted awake by Emmaly's shrill shriek. Still groggy I rubbed the sleep from my eyes and glanced around. I was on a train. The train was stopped. We were at a station – Timaru? This was not my stop. Confused, I turned to my friend Oliver. He shrugged his hunched shoulders in response to my raised eyebrow and nodded towards Emmaly.

Emmaly's face was pressed tightly against the glass window. Somehow I knew her teal rimmed contacts were busy recording whatever had caused her excited scream.

"I can't believe it! They're here!" she squealed, her maroon curls escaping from their Victorian coiffed prison.

"Well unless *they* are an army of invading aliens determined on world domination and we are humanity's last hope, I am going back to sleep," I informed her snuggling deeper into the comfortable seat. I *so* did not do mornings.

"Oh it's way better than aliens," Emmaly assured me, "It's Indisposed Affection."

I shot up. "Seriously?"

"Seriously."

In a flash I was by her side, craning my neck to catch a glimpse of my favourite band. That's when I spotted the iconic tower of turquoise hair wired up to defy gravity and the mismatched mop of messy black hair beside it. Riley London and Taylor Lee – the sexiest things since sliced bread, or maybe a French baguette because sliced bread was more practical than sexy. However, my excitement was short lived as a moment later the two musicians vanished from view.

Behind me, I heard Oliver stand up. Turning I watched him pull down my navy backpack from the overhead compartment. He tossed it to me. Not waiting to see if I caught it, he reached up and grabbed Emmaly's and his own bag.

"Let's go," he said with a wink. Emmaly didn't have to be told twice.

I remained where I was, dumbfounded. "Wait what? What about our weekend getaway?" I whined but my friends had already disappeared. I swore and chased after them.

No sooner had I stepped onto the platform when the train's last call whistled out through the station. I glanced around, still no sign of Emmaly and Oliver. Frustrated, I ran my fingers through my hair. Just then my phone rang.

"Please tell me you're not still on the train," Emmaly said.

"You mean the train that just pulled out of the station? No, I'm not on the train," I replied.

"Good," Oliver interjected "Cause we've just rented bicycles."

"Bicycles," I repeated.

"Ya, we think they are going to take the cycle trek to Lake Tekapo."

"Oliver, I thought you hated cycling."

"I do. But this is Indisposed Affection we're talking about and if we hurry we could still catch them."

We raced through town earning at least one or two angry glares as we weaved around the local cyclists completing their Saturday morning errands. The fastest of the three, I was just rounding an intersection when suddenly I caught sight of the band. Riley's signature hair may have been masked by a bike helmet, but the duo's unique style was undeniably conspicuous, even from a distance.

I glanced back over my shoulder to signal my friends and my heart stopped. All of Oliver's attention was focused on keeping up with Emmaly. He didn't see the car heading straight towards him. The car that was not slowing down. The car being driven by a misplaced driver, who judging by his blank stare, was paying more attention to the GPS arrows on his Google contacts than the actual road. Obviously, not all inventions are good ones.

I screamed just as the driver slammed on the brakes. At the last minute Oliver swerved, avoiding the collision but losing his balance and toppling to the ground.

"Are you okay?" Emmaly and I asked rushing over.

"I'm fine," He reassured us picking himself up. "But honestly, who still drives a car? What is this, the 2010s?" He complained.

While Oliver brushed himself off, I glanced around for any signs of Indisposed Affection but during the commotion they had slipped away behind a row of city buses.

Somehow, Emmaly, Oliver and I managed to make it out of town alive. Despite my earlier annoyance at the last minute change of plans, I was thoroughly enjoying myself as we cruised down the highway. This was exactly what weekend getaways were supposed to be like, although I doubted we'd actually make it to Lake Tekapo at the rate Oliver was puffing along. Luckily, there were a number of bus and train stations along the route. It wouldn't be that hard to make our way back home.

I was also thankful the weather had cleared up. The day was hot but there was a refreshing breeze to keep us cool. The last few weeks had been quite stormy and I really didn't want to return home and find my basement apartment flooded again.

We'd been cycling for about an hour when Oliver came to an abrupt halt in front of a grey stone church.

"That's it, I'm done," he announced.

"But Indisposed Affection," Emmaly pouted.

"Not to mention the fact that this whole crazy thing was your idea," I pointed out.

"Ya, well I guess I didn't think it through properly," he admitted. I tried my best not to roll my eyes. Oliver not thinking things through was not exactly news.

"So now what?" I asked.

"I guess we could check out the town," Oliver suggested.

It was a small town, nowhere I'd ever stopped before, but because of all the tourists cycling through it had developed its own quirky charm. We biked around until we stumbled upon a quaint little coffee shop tucked between a florist and a bank. Two cats sat sentinel like a pair of Chinese guardian lions. They paid us just as much attention as their stone counterparts would have.

Collapsing onto the nearest chair, Oliver announced, "I am never getting out of this seat." Emmaly laughed.

The café owner was pleasantly plump woman in her early sixties. She wore an emerald robe-inspired-ensemble and had deep purple hair with the scarlet fringe that was so popular with women of her generation.

“Welcome to The Dizzy Pagoda. What can I get you?” she greeted us. Her voice had a pleasant although slightly dodderly lilt to it. “I just made some fresh scones. Apart from the coffee beans, all our food is locally grown,” she added. I saw Emmaly try to hide a smile. Elders can be a little out of touch sometimes. Nowadays it was very rare to find something that was not locally grown.

At that moment one of the cats, a large green-eyed ginger, strutted into the store. The tom took one look at the owner and hissed. Oliver jumped.

The owner chuckled at Oliver’s surprised expression. “Oh don’t mind him,” the woman told us unconcerned. “He still hasn’t forgiven me for going to America for six months. But really, since one can only afford to fly once every ten years these days you might as well stay for a while.” Emmaly and I exchanged another amused glance. Like I said, elders could be a bit out of touch sometimes; no one in our generation would admit to flying so far away just for a holiday.

Our conversation was interrupted by a loud crash from the back room. At first I assumed it was only the cat, but a second later a person emerged. A person sporting a tower of blue hair.

“Riley London!” Emmaly exclaimed.

Startled, Riley blinked blankly at us for a moment before breaking into an infectious grin.

“We are huge fans,” Oliver swooned. It was a good thing that he was already sitting down because I didn’t think his legs could support him.

“Thanks,” Riley said. “It means a lot.” Then turning to the café owner Riley continued, “By the way Aunt K have you seen my extra guitar picks. Taylor and I are looking for them.”

“Taylor’s here too?” I asked eagerly.

“Did you just say aunt?”

“Have you tried looking under the flower pot in the shed?” The café owner suggested. Riley looked just as mystified as the rest of us as to why guitar picks would be under a flower pot.

“Um no, I did not think to look there.” Riley studied us for a moment, “You guys said you were fans right? Taylor and I were just about to have a jam session. Did you want to listen?”

“Yes,” the words were out of my mouth before Riley had even finished the invitation.

“And you wanted to stay on the train,” Oliver teased.

I shrugged. “I was wrong,” I said, my breathe catching as Taylor strolled into the room.

Those were the first words Taylor Lee ever heard me say and it would not be the only time those words would pass between us.

Appendix C

Textbook Intervention

The following is an excerpt from Forget about the Sheep: A History of New Zealand Tourism published in 2050.

The rise of slow travel 2010-2050

Another major shift in the tourism industry was the popularization of the slow travel movement which occurred towards the end of the first decade of the century. An extension of the slow food movement, the slow travel movement argued people should enjoy the journey not just the destination. It advocated moving away from fast, direct modes of transportation like airplanes to more flexible modes such as trains and bicycles, which give passengers more freedom to stop and experience different communities and events on route to their final destination.

Up until the early 2020s air travel had become increasingly more affordable resulting in more people flying more often. However, heavy taxes and restrictions from strict climate change mediation policies forced airplane companies to increase ticket prices. This led to the decline and eventual elimination of budget airlines. As flying and driving became more expensive travellers began turning towards slow travel. At the same time, increased government investment in public transit infrastructure across the country created a lattice of connecting bicycle paths, buses and trains that further supported the growth of slow travel in New Zealand by making it more easy and accessible for travellers to use. Incidentally, this increased infrastructure also contributed to the decrease in personal car ownership (see chapter 5.2).

Additionally, slow travel's mantra of stopping along the journey has stimulated the economies of many small cities and towns that had previously gone largely ignored by tourists. This led to a rise in small businesses such as Bed and Breakfasts and cafés, both of which supported local food production. Since traveling by bus, bicycle and train took longer than travelling by airplane people, not wanting to take more time off work, began trading their international holidays for local trips keeping their travel dollars within their local economy.

While the last few years of increased storms around New Zealand's South Island has slightly influenced tourists' cycling habits, slow travel continues to grow. Today, it is one of the most common forms of travel. However, many millennials, gen x and gen y'ers continue to fly overseas for holidays. Since flying has become so expensive most of these pensioners can only afford to fly about once every ten years. Because of this they tend to spend many months at the destination.

Overall, the last 40 years have seen a massive change in the tourism industry. The uptake of slow tourism saw a massive decline in flying behaviour and overseas travel and a shift towards more frequent, local holidays. As technology and traveling tastes continue to evolve it will be interesting to see what the next 40 years have in store.

Appendix D

Story Intervention Design Justification

Text	Element	Rational	Literature
New Zealand, November 2050	Unnamed, ungendered, first person narration	Story Element - Persuasion (Increase identification with the main character)	Moyer-Gusé & Nabi, 2010
<p>I was jolted awake by Emmaly's shrill shriek. Still groggy I rubbed the sleep from my eyes and glanced around. I was on a train. The train was stopped. We were at a station – Timaru? This was not my stop. Confused, I turned to my friend Oliver. He shrugged his hunched shoulders in response to my raised eyebrow and nodded towards Emmaly.</p> <p>Emmaly's face was pressed tightly against the glass window. Somehow I knew her teal rimmed contacts were busy recording whatever had caused her excited scream.</p> <p>"I can't believe it! They're here!" she squealed, her maroon curls escaping from their Victorian coiffed prison.</p> <p>"Well unless <i>they</i> are an army of invading aliens determined on world domination and we are humanity's last hope, I am going back to sleep," I informed her snuggling deeper into the comfortable seat. I <i>so</i> did not do mornings.</p> <p>"Oh it's way better than aliens," Emmaly assured me, "It's Indisposed Affection."</p> <p>I shot up. "Seriously?"</p> <p>"Seriously."</p> <p>In a flash I was by her side, craning my neck to catch a glimpse of my favourite band. That's when I spotted the iconic tower of turquoise hair wired up to defy gravity and the mismatched mop of messy black hair beside it. Riley London and Taylor Lee – the sexiest things since sliced bread, or maybe a French baguette because sliced bread was more practical than sexy. However, my excitement was short lived as a moment later the two musicians vanished from view.</p> <p>Behind me, I heard Oliver stand up. Turning I watched him pull down my navy backpack from the overhead compartment. He tossed it to me. Not waiting to see if I caught it, he reached up and grabbed Emmaly's and his own bag.</p> <p>"Let's go," he said with a wink. Emmaly didn't have to be told twice.</p> <p>I remained where I was, dumbfounded. "Wait what? What about our weekend getaway?" I whined but my friends had already disappeared. I swore and chased after them.</p> <p>No sooner had I stepped onto the platform when the train's last call whistled out through the station. I glanced around, still no sign of Emmaly and Oliver. Frustrated, I ran my fingers through my hair. Just then my phone rang.</p>	Greater use of trains	Key Travel Element	Ceron & Dubois, 2007; Newman, Kenworthy, & Glazebrook, 2013
	The primary plot of the story is about chasing a band.	Story Element - Persuasion (Increase subtlety of the message and decrease counterarguing)	Moyer-Gusé & Nabi, 2010
	Unisex names	Story Element - Persuasion (Increase identification with the main character)	Moyer-Gusé & Nabi, 2010

Text	Element	Rational	Literature
<p>Please tell me you're not still on the train," Emmaly said.</p> <p>"You mean the train that just pulled out of the station? No, I'm not on the train," I replied.</p> <p>"Good," Oliver interjected "Cause we've just rented bicycles."</p> <p>"Bicycles," I repeated.</p> <p>"Ya, we think they are going to take the cycle trek to Lake Tekapo."</p> <p>"Oliver, I thought you hated cycling."</p> <p>"I do. But this is Indisposed Affection we're talking about and if we hurry we could still catch them."</p> <p>We raced through town earning at least one or two angry glares as we weaved around the local cyclists completing their Saturday morning errands. The fastest of the three, I was just rounding an intersection when suddenly I caught sight of the band. Riley's signature hair may have been masked by a bike helmet, but the duo's unique style was undeniably conspicuous, even from a distance.</p> <p>I glanced back over my shoulder to signal my friends and my heart stopped. All of Oliver's attention was focused on keeping up with Emmaly. He didn't see the car heading straight towards him. The car that was not slowing down. The car being driven by a misplaced driver, who judging by his blank stare, was paying more attention to the GPS arrows on his Google contacts than the actual road. Obviously, not all inventions are good ones.</p> <p>I screamed just as the driver slammed on the brakes. At the last minute Oliver swerved, avoiding the collision but losing his balance and toppling to the ground.</p> <p>"Are you okay?" Emmaly and I asked rushing over.</p> <p>"I'm fine," He reassured us picking himself up. "But honestly, who still a drives a car? What is this, the 2010s?" He complained.</p> <p>While Oliver brushed himself off, I glanced around for any signs of Indisposed Affection but during the commotion they had slipped away behind a row of city buses.</p> <p>Somehow, Emmaly, Oliver and I managed to make it out of town alive. Despite my earlier annoyance at the last minute change of plans, I was thoroughly enjoying myself as we cruised down the highway. This was exactly what weekend getaways were supposed to be like, although I doubted we'd actually make it to Lake Tekapo at the rate Oliver was puffing</p>	<p>More bicycling</p> <p>More bicycling</p> <p>Less driving</p>	<p>Key Travel Element</p> <p>Key Travel Element</p> <p>Key Travel Element – Considered a more extreme shift (describe the ideal world you want to see)</p>	<p>Harré, 2011; Pucher & Buehler, 2017</p> <p>Harré, 2011; Pucher & Buehler, 2017</p> <p>Harré, 2011; Newman & Kenworthy, 2011; Peeters & Dubois, 2010</p>

Text	Element	Rational	Literature
<p>along. Luckily, there were a number of bus and train stations along the route. It wouldn't be that hard to make our way back home.</p>	Greater use of trains and public transport	Key Travel Element	Ceron & Dubois, 2007; Newman, Kenworthy, & Glazebrook, 2013
<p>I was also thankful the weather had cleared up. The day was hot but there was a refreshing breeze to keep us cool. The last few weeks had been quite stormy and I really didn't want to return home and find my basement apartment flooded again. We'd been cycling for about an hour when Oliver came to an abrupt halt in front of a grey stone church.</p> <p>"That's it, I'm done," he announced.</p> <p>"But Indisposed Affection," Emmaly pouted.</p> <p>"Not to mention the fact that this whole crazy thing was your idea," I pointed out.</p> <p>"Ya, well I guess I didn't think it through properly," he admitted. I tried my best not to roll my eyes. Oliver not thinking things through was not exactly news.</p> <p>"So now what?" I asked.</p> <p>"I guess we could check out the town," Oliver suggested.</p> <p>It was a small town, nowhere I'd ever stopped before, but because of all the tourists cycling through it had developed its own quirky charm. We biked around until we stumbled upon a quaint little coffee shop tucked between a florist and a bank. Two cats sat sentinel like a pair of Chinese guardian lions. They paid us just as much attention as their stone counterparts would have.</p> <p>Collapsing onto the nearest chair, Oliver announced, "I am never getting out of this seat." Emmaly laughed.</p> <p>The café owner was pleasantly plump women in her early sixties. She wore an emerald robe-inspired-ensemble and had deep purple hair with the scarlet fringe that was so popular with women of her generation</p> <p>"Welcome to The Dizzy Pagoda. What can I get you?" she greeted us. Her voice had a pleasant although slightly dodderly lilt to it. "I just made some fresh scones. Apart from the coffee beans, all our food is locally grown," she added. I saw Emmaly try to hide a smile. Elders can be a little out of touch sometimes. Nowadays it was very rare to find something that was not locally grown.</p>	Climate change will cause more storms and flooding in the New Zealand South Island	Effects of climate change (realistic –align with scientific predictions)	Lowe et al., 2006; Ministry for the Environment, 2017; New Zealand Climate Change Centre, 2010
	More bicycling	Key Travel Element	Harré, 2011; Pucher & Buehler, 2017
	Food is locally grown		Yeoman, 2012

Text	Element	Rational	Literature
At that moment one of the cats, a large green-eyed ginger, strutted into the store. The tom took one look at the owner and hissed. Oliver jumped.			
The owner chuckled at Oliver's surprised expression. "Oh don't mind him," the woman told us unconcerned. "He still hasn't forgiven me for going to America for six months. But really, since one can only afford to fly once every ten years these days you might as well stay for a while." Emmaly and I exchanged another amused glance. Like I said, elders could be a bit out of touch sometimes; no one in our generation would admit to flying so far away just for a holiday.	Flights more expensive Less flying Less international travel/ more local travel	Key Travel Element Key Travel Element Key Travel Element	Ceron & Dubois, 2007; Yeoman, 2012 Peeters & Dubois, 2010;
Our conversation was interrupted by a loud crash from the back room. At first I assumed it was only the cat, but a second later a person emerged. A person sporting a tower of blue hair.			
"Riley London!" Emmaly exclaimed.			
Startled, Riley blinked blankly at us for a moment before breaking into an infectious grin.			
"We are huge fans," Oliver swooned. It was a good thing that he was already sitting down because I didn't think his legs could support him.			
"Thanks," Riley said. "It means a lot." Then turning to the café owner Riley continued, "By the way Aunt K have you seen my extra guitar picks. Taylor and I are looking for them."			
"Taylor's here too?" I asked eagerly.			
"Did you just say aunt?"			
"Have you tried looking under the flower pot in the shed?" The café owner suggested. Riley looked just as mystified as the rest of us as too why guitar picks would be under a flower pot.			
"Um no, I did not think to look there." Riley studied us for a moment, "You guys said you were fans right? Taylor and I were just about to have a jam session. Did you want to listen?"			
"Yes," the words were out of my mouth before Riley had even finished the invitation.			
"And you wanted to stay on the train," Oliver teased.			
I shrugged. "I was wrong," I said, my breathe catching as Taylor strolled into the room.			
Those were the first words Taylor Lee ever heard me say and it would not the only time those words would pass between us.			

Appendix E

Textbook Intervention Design Justification

Text	Element	Rational	Literature
<i>The following is an excerpt from Forget about the Sheep: A History of New Zealand Tourism published in 2050.</i>			
<u>The rise of slow travel 2010-2050</u>			
<p>Another major shift in the tourism industry was the popularization of the slow travel movement which occurred towards the end of the first decade of the century. An extension of the slow food movement, the slow travel movement argued people should enjoy the journey not just the destination. It advocated moving away from fast, direct modes of transportation like airplanes to more flexible modes such as trains and bicycles, which give passengers more freedom to stop and experience different communities and events on route to their final destination.</p>	Slow travel	Key Travel Element	Dickinson, Lumsdon, & Robbins, 2011
	Less flying	Key Travel Element	Ceron & Dubois, 2007
<p>Up until the early 2020s air travel had become increasingly more affordable resulting in more people flying more often. However, heavy taxes and restrictions from strict climate change mediation policies forced airplane companies to increase ticket prices. This led to the decline and eventual elimination of budget airlines. As flying and driving became more expensive travellers began turning towards slow travel. At the same time, increased government investment in public transit infrastructure across the country created a lattice of connecting bicycle paths, buses and trains that further supported the growth of slow travel in New Zealand by making it more easy and accessible for travellers to use. Incidentally, this increased infrastructure also contributed to the decrease in personal car ownership (see chapter 5.2).</p>	Flights more expensive	Key Travel Element	Ceron & Dubois, 2007; Yeoman, 2012 Dickinson, Lumsdon, & Robbins, 2011 Ceron & Dubois, 2007; Newman, Kenworthy, & Glazebrook, 2013 Harré, 2011; Pucher & Buehler, 2017 Harré, 2011; Newman & Kenworthy, 2011; Peeters & Dubois, 2010
	Slow travel	Key Travel Element	
	Greater use of trains and public transport	Key Travel Element	
		Key Travel Element	
	More bicycling	Key Travel Element	
	Slow Travel		
	Less driving	Key Travel Element – Considered a more extreme shift (describe the ideal world you want to see)	

Text	Element	Rational	Literature
<p>Additionally, slow travel's mantra of stopping along the journey has stimulated the economies of many small cities and towns that had previously gone largely ignored by tourists. This led to a rise in small businesses such as Bed and Breakfasts and cafés, both of which supported local food production. Since traveling by bus, bicycle and train took longer than travelling by airplane people, not wanting to take more time off work, began trading their international holidays for local trips keeping their travel dollars within their local economy.</p>	Greater use of trains and public transport	Key Travel Element	<p>Ceron & Dubois, 2007; Newman, Kenworthy, & Glazebrook, 2013 Harré, 2011; Pucher & Buehler, 2017 Peeters & Dubois, 2010; Yeoman, 2012</p>
	More bicycling	Key Travel Element	
	Less international travel/ more local travel	Key Travel Element	
<p>While the last few years of increased storms around New Zealand's South Island has slightly influenced tourists' cycling habits, slow travel continues to grow. Today, it is one of the most common forms of travel. However, many millennials, gen x and gen y'ers continue to fly overseas for holidays. Since flying has become so expensive most of these pensioners can only afford to fly about once every ten years. Because of this they tend to spend many months at the destination.</p>	Climate change will cause more storms and flooding in the New Zealand South Island	Effects of climate change (realistic –align with scientific predictions)	<p>Lowe et al., 2006; Ministry for the Environment, 2017; New Zealand Climate Change Centre, 2010 Ceron & Dubois, 2007; Yeoman, 2012</p>
	Flights more expensive	Key Travel Element	
<p>Overall, the last 40 years have seen a massive change in the tourism industry. The uptake of slow tourism saw a massive decline in flying behaviour and overseas travel and a shift towards more frequent, local holidays. As technology and traveling tastes continue to evolve it will be interesting to see what the next 40 years have in store.</p>	Less flying	Key Travel Element	<p>Ceron & Dubois, 2007; Peeters & Dubois, 2010; Yeoman, 2012</p>
	Less international travel/ more local travel	Key Travel Element	

Appendix F

Temporal Distance Survey



Traveling Toward 2050

Welcome to the survey Travelling Towards 2050

What is the aim of the project?

This is a survey carried out by researchers from the University of Otago investigating people's perceptions of travel in the year 2050.

What types of participants are being sought?

We are looking for participants over the age of 18.

What will participants be asked to do?

The survey should take less than 10 minutes to complete. Taking part in this survey is voluntary. No identifying data will be collected and you can withdraw at anytime without any disadvantage to yourself.

The data collected will be securely stored in a lockable drawer in a locked office in the Centre for Science Communication. Data obtained as a result of the research will be retained for at least 5 years in secure storage. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve your anonymity.

This study has been approved by the University of Otago Human Ethics Committee. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (ph +64 3 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

If you have any questions about this project, either now or in the future, feel free to contact either:

Jean Fletcher (fleje401@student.otago.ac.nz)
Prof Nancy Longnecker (nancy.longnecker@otago.ac.nz)
Centre for Science Communication, University of Otago
+(64) 3 479 7885

Thank you for your help!

* 1. By selecting "yes" I agree to the following:

- i) That I am over the age of 18
- ii) That I understand the information associated with this project.
- iii) I am willing to participate in this project

☐ Yes

Traveling Toward 2050

Demographics

2. I am:

- ☐ 18-19
- ☐ 20-24
- ☐ 25-29
- ☐ 30-34
- ☐ 35-39
- ☐ 40-49
- ☐ 50-59
- ☐ 60+

3. I am:

- ☐ Male
- ☐ Female
- ☐ Other
- ☐ I'd rather not say

4. I am (nationality):

5. The highest level of education that I have completed is:

- ☐ High School Diploma
- ☐ Community College/ Technical College
- ☐ Undergraduate
- ☐ Postgraduate diploma/ certificate
- ☐ Master's Degree
- ☐ PhD
- ☐ Apprenticeship
- ☐ Other (please specify)

Traveling Toward 2050

Visualizing the Future

6. How clearly can you imagine the year 2050

Not at all clearly Not very clearly Somewhat clearly Very clearly

☐☐☐☐

7. Do you think travelling in 2050 will be any different than travelling in 2015?

- ☐ Yes
- ☐ No
- ☐ I don't know

Traveling Toward 2050

Visualizing the Future Continued

8. How do you think travelling in 2050 will be different than travelling in 2015?

Traveling Toward 2050








9. Indicate the extent to which you agree with the following statements.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I rarely count on good things happening to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Advancing technology provides us with hope for the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Business interests have more political power than individuals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Humans have the right to modify the natural environment to suit their needs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am always optimistic about my future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Future resource shortages will not be solved by technology.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are limits to growth beyond which our industrialized society cannot expand.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Traveling Toward 2050

Risk

10. Rank in order of concern (*with 1 representing the issue you are most worried about*)

	<input type="text" value="1"/>	AIDS
	<input type="text" value="2"/>	Radioactive waste
	<input type="text" value="3"/>	Loss of biodiversity
	<input type="text" value="4"/>	Genetic modification
	<input type="text" value="5"/>	Climate change
	<input type="text" value="6"/>	Nuclear power
	<input type="text" value="7"/>	Terrorism

11. I am:

- ☐ Very concerned about climate change
- ☐ Somewhat concerned about climate change
- ☐ Not too concerned about climate change
- ☐ Not at all concerned about climate change
- ☐ Climate change does not exist

Traveling Toward 2050

12. If you have any other comments please provide them here.

Thank you so much for your participation.

Appendix G

Internal Validity for Total Optimism

Mean inter-item correlations for future optimism in the Temporal Distance Survey (See Appendix F)

	N	Percent
Valid Cases	1062	99.2
Excluded Cases	9	.8
Total Cases	1071	100

Inter-Item Correlation Matrix for Future Optimism

	I often count on good things happening to me.	Advancing technology provides us with hope for the future.	I am always optimistic about my future.	Future resource shortages will be solved by technology.
I often count on good things happening to me.	1.000	.118	.388	.131
Advancing technology provides us with hope for the future.	.118	1.000	.262	.248
I am always optimistic about my future.	.388	.262	1.000	.098
Future resource shortages will be solved by technology	.131	.248	.098	1.000

Summary Item Statistics

	Mean	Minimum	Maximum	Variance	N of Items
Inter-Item Correlations	.208	.098	.388	.011	4

The Mean inter-item correlation is 0.208. This falls between the acceptable range of 0.2 and 0.40 meaning that there is a good level of internal consistency (Pallant, 2016).

Appendix H

Intercoder reliability (Three coders)

Expectations of future travel Temporal Distance Survey

Theme	Code	Percent Agreement	Krippendorff's Alpha
Future travel will use new forms		93.333%	0.844
	Self-driving vehicles	96.667%	0.916
Future travel will be faster		100%	1
Future travel will be more environmentally sustainable	Change in transport behaviour	96.667%	0.891
	Use less fossil fuels	100%	1
	Becoming more eco-friendly	96.667%	0.785

Expectations of future travel Story Survey

Theme	Code	Percent Agreement	Krippendorff's Alpha
Travel will use high carbon transport systems	High carbon transport	93.3%	0.839
	Increase in air travel	100%	1
Travel will use low carbon transport systems	Use less fossil fuels	93.3%	0.859
	Change in transport behaviours	96.7%	0.903
	Become more environmentally friendly	100%	1
Travel will use systems that could reinforce high carbon systems	Faster travel	96.7%	0.926
	Space Travel	100%	1
Travel will use systems that could reinforce low carbon systems	Changes in travel	93.3%	0.825
	Slower travel	100%	1
	Return to older forms of travel technology	100%	1
	Changes in travel	86.7%	0.723

Appendix I

Invitation to participate in research

Email

Invitation to participate in research

How will you Travel in 2050?

Tell us and you could win \$100 US Amazon gift card (store negotiable upon winning).



As part of a PhD research study at The University of Otago, we are now seeking volunteers to complete a simple, short online survey. This study aims to give us a better understanding of people's perceptions of travel and tourism in the year 2050.

The survey takes 10-15 minutes, is anonymous, confidential and can be completed online. For more information and to take part in this research, please visit <http://www.surveymoz.com/s3/2534281/Stories-and-the-Future-Jean>. This survey is purely for research purposes; you will NOT be contacted for commercial or marketing purposes. This study has been approved by the University of Otago's Human Research Ethics Committee. Please spread the word and share with your friends.

Twitter

Travelling in 2050? What do you think the future holds? For more information and to take part in this research, please visit [hyperlink to information sheet and consent form webpage]. #travel2050

Facebook

Hi everyone, as you may know my PhD is looking at people's perceptions of travel and tourism in the year 2050 and I'd love to include your perspective. For more information and to take part in this research, please visit [hyperlink to information sheet and consent form webpage]. PS don't forget to share with all your friends.



How Will You Travel in 2050?

Tell us and you could **WIN** \$100US Amazon*gift card.

As part of a PhD research study at The University of Otago, we are now seeking volunteers to complete a simple, short online survey. The survey takes just 10-15 minutes, is anonymous, confidential and can be completed online.

*Store of gift card negotiable upon winning

Flyer

How Will You Travel in 2050?



Tell us and you could **win** \$100 US Amazon* gift card.

As part of a PhD research study at The University of Otago, we are now seeking volunteers to complete a simple, short online survey. This study aims to give us a better understanding of people's perceptions of travel and tourism in the year 2050. The survey takes 10-15 minutes, is anonymous, confidential and can be completed online. This survey is purely for research purposes; you will NOT be contacted for commercial or marketing purposes. This study has been approved by the University of Otago's Human Research Ethics Committee (Ref: D15/393.).

For more information and to take part in this research, please visit <http://www.surveymonkey.com/s/2534281/Stories-and-the-Future-Jean>



*store negotiable upon winning

Appendix J

Ethics Approval



D15/393

Academic Services
Manager, Academic Committees, Mr Gary Witte

Professor N Longnecker
Centre for Science Communication
303A Great King Street

4 March 2016

Dear Professor Longnecker,

I am writing to confirm for you the status of your proposal entitled "**Using stories to make sense of our Changing World**", which was originally received on December 8, 2015. The Human Ethics Committee's reference number for this proposal is D15/393.

The above application was Category B and had therefore been considered within the Department or School. The outcome was subsequently reviewed by the University of Otago Human Ethics Committee. The outcome of that consideration was that the proposal was approved.

Approval is for up to three years from the date of HOD approval. If this project has not been completed within three years of this date, re-approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Gary Witte'.

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz



D15/393

Academic Services
Manager, Academic Committees, Mr Gary Witte

26 October 2016

Professor N Longnecker
Centre for Science Communication
133 Union St East

Dear Professor Longnecker,

I am again writing to you concerning your proposal entitled **"Using stories to make sense of our Changing World"**, Ethics Committee reference number D15/393.

Thank you for your request for amendment dated 19 October 2016. We note that following analysis of the data from the original survey, Jean Fletcher will repeat the survey with amendments made to the title, questions. Thank you for advising that distribution will now be via SurveyMonkey and the survey will be sent to 1000 Americans. We note the title of the Survey is now "Travelling towards 2050." to reflect the amended focus. Thank you for providing a copy of the revised survey. We confirm the amendments are approved.

Your proposal continues to be fully approved. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing. I hope all goes well for you with your upcoming research.

Yours sincerely,

A handwritten signature in dark ink, appearing to read 'Gary Witte'.

Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

c.c. Professor L S Davis Director Centre for Science Communication

Appendix K

Information for Participants



USING STORIES TO MAKE SENSE OF OUR CHANGING WORLD

INFORMATION FOR PARTICIPANTS

Thank you for your interest in this project. Please read this information sheet before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the aim of the project?

This project is investigating people's visualization of holiday travel in 2050 and how this may influence perceptions of the future. It also explores effect of short stories on people's visualization of the future. This project is part of the research for Jean Fletcher's PhD degree in Science Communication.

What types of participants are being sought?

We are looking for participants over the age of 18. No contact details are required; participants willing to participate in follow up interviews and/or a prize draw for a \$100US gift card to Amazon (or similar) can elect to provide an email address. These lists will be stored in a secure server or locked office at the University of Otago and destroyed after prizes have been distributed. Participants are encouraged to share the survey link through email, Facebook, Instagram and/or Twitter.

What will participants be asked to do?

Should you agree to take part in this project, this three-part survey should take less than fifteen minutes. First, you will be asked to complete a brief questionnaire regarding what you imagine holiday travel in 2050 will be like. This first part also involves a few questions regarding how you might decide about your future holidays. Second, you will be asked to read about 1500 words of text. Thirdly, you will be asked a few follow up questions.

As this research deals with unknown futures and risk, it is possible (although unlikely) that you could experience slight discomfort or unease. Remember that you may withdraw from the project at any time without any disadvantage to yourself.

What data or information will be collected and what use will be made of it?

Participants are not required to provide any personal details; however, email addresses will be collected for people who wish to participate in the prize draw so that we are able to inform the winner(s). Similarly, email addresses will be collected from survey participants willing to take part in a later interview so that we can contact them (as well as send them transcript summaries to ensure we have accurately recorded what was said). Interviews will be audio recorded and transcribed. The only people who will have access to this project's data will be the researchers, supervisors and research assistants.

The data collected will be securely stored in a lockable drawer in a locked office in the Centre for Science Communication. Data obtained as a result of the research will be retained for **at least 5 years** in secure storage. Any personal information held on the participants such as email addresses will be destroyed at the publication of the research even though the data derived from the research will, in most cases, be kept for much longer or possibly indefinitely.

The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve your anonymity. A summary of results will be made available from the website of the Centre for Science

Interviews

For participants who agree to a follow up interview, the interview will be conducted via skype, telephone or face-to-face, as determined by logistics and your preference. A semi-structured interview technique will be used. The general line of questioning will include perceptions about holiday travel in the year 2050 and how you think you will make decisions about your travel. In the event that you feel hesitant or uncomfortable you are reminded of your right to decline to answer any particular question(s) or to withdraw from the project.

Can participants change their mind and withdraw from the project?

Yes, you may withdraw from participation in the project at any time and without any disadvantage.

What if participants have any questions?

If you have any questions about this project, either now or in the future, feel free to contact either:

Jean Fletcher
Centre for Science Communication
fleje401@student.otago.ac.nz

or

Prof Nancy Longnecker
Centre for Science Communication
nancy.longnecker@otago.ac.nz

+(64) 3 479 7885

This study has been approved by the Department stated above. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

Appendix L
Interview script

Thank you for agreeing to participate in this short interview. If there are any questions that you do not want to answer, or if you want to quit at any time that is fine, just let me know. You will still be entered into the draw. This interview will be recorded so that I don't miss anything.

1. In the last 18 months, have you changed the way you travel or the way you think about travel (including daily commutes or international holidays).
2. Is there any way in which you would like to change how you travel but haven't been able to?
 - a. What are the barriers stopping you from making this change?
3. Last year you participated in an online survey investigating perceptions of travel in the year 2050. In this survey, you were asked to read a short text.
 - a. Do you remember anything about the text?
If so what?

Probing questions:

For participants who read the...

TEXTBOOK	STORY
<i>It was a hypothetical history of how travel would change in NZ over the next 30 years.</i> <ul style="list-style-type: none"> Do you remember how the modes of transportation had changed? Do you remember anything about how often or where people travelled to? 	<i>It was a short story about three friends chasing a band around NZ.</i> <ul style="list-style-type: none"> Do you remember what modes of transportation they used to travel around NZ? In this fictional representation of NZ in 2050, do you remember anything about how often or where people travelled to?

4. For the next question, pick the option that best describes your feelings.

Do think that the information provided in the text had any impact on the way you think about travel. The options are:

It did not affect how I think about travel

It made me start thinking a little differently about how I travel

It completely changed how I think about travel

If so, in what way?

5. Thank you so much for your time.
Is there anything else you would like to say?

Appendix M:

Coding manual for expectations of future travel in the Temporal Distance Survey

Coding Rules

1. If the code is present mark 1.
2. The number of times a code is present within each quote *is not* recorded. Only the presence or absence of the code is noted.
3. Each quote can contain multiple codes.
4. If an answer has conflicting views or multiple depictions of the future code for all.

Theme	Code	Description	Include	Exclude	Examples
Future travel will use new forms of travel technology.		<ul style="list-style-type: none"> Reference to new or improved types of technology or technology that has not been invented yet. This includes general references to unknown or unspecified change in technology. 	<ul style="list-style-type: none"> flying cars or buses, virtual reality, space, teleportation, electric cars and bikes, magnetic trains, design changes, more fuel efficient, Smart cars, high speed trains 	<ul style="list-style-type: none"> Autonomous vehicles, Self-driving vehicles, Driverless vehicles, Robot controlled vehicles 	<ul style="list-style-type: none"> “A lot more hovering and less effort to get from place to place.” “More high-tech, but can't think of any specific invention/ technology”
	Self-driving vehicles	<ul style="list-style-type: none"> References to vehicles that can operate without a human driver. 	<ul style="list-style-type: none"> Autonomous vehicles, Self-driving vehicles, Driverless vehicles, Robot controlled vehicles 	<ul style="list-style-type: none"> Smart cars, general references to automation 	<ul style="list-style-type: none"> “I think that there will be more self driving cars...”

Theme	Code	Description	Include	Exclude	Examples
Future travel will be faster		<ul style="list-style-type: none"> • Reference to travelling becoming faster • References to travel taking less time • References to trains/ airplanes/ cars that can travel at higher speeds • References to instantons travel (ie teleportation) 	<ul style="list-style-type: none"> • Faster, • Time saving, • Time efficient, • High speed air travel, • Bullet trains, • Teleportation, 	<ul style="list-style-type: none"> • Unspecified references to efficiency (because they could mean time or fuel) 	<ul style="list-style-type: none"> • “Hopefully it will be faster.” • “Faster jet plane travel.”
“Future travel will be more environmentally sustainable	Change in transport behaviour	<ul style="list-style-type: none"> • References to transport that can accommodate many people at once (excluding airplanes and cruise ships) • References suggesting a decrease in flying behaviour (either less people flying or people flying less often) • References suggesting there are less cars being used or less individual ownership of cars • References suggesting there is less international travel or that people are travelling more locally 	<ul style="list-style-type: none"> • More public transport • More trains, • Hyperloop, • Carpooling, • Less flying, • Less people flying, • Less cars, • Communal car ownership • More local travel, 	<ul style="list-style-type: none"> • Airplanes and cruise ships as types of more sustainable mass transport • Flying cars when referring to less flying 	<ul style="list-style-type: none"> • “...more people will be using light rail, subways, moving sidewalks; people movers.” • “Less people driving and more car sharing services.”
	Use less fossil fuels	<ul style="list-style-type: none"> • References to decreasing the use of fossil fuel • References to vehicles becoming more fuel efficient • Reference to using alternative fuel sources 	<ul style="list-style-type: none"> • Increasing fuel efficiency • Alternative fuel, • Electric power • Solar power • Hybrid • Bicycles • Horses 		<ul style="list-style-type: none"> • “No fossil fuels...” • “Mostly electric vehicles and more mass transit.”
	Becoming more eco-friendly	<ul style="list-style-type: none"> • Any general catch-all phrase referring to travel becoming more sustainability that is not covered in any of the above categories. 	<ul style="list-style-type: none"> • Eco-friendly • Greener • Less harmful to the environment • More sustainable 	<ul style="list-style-type: none"> • General references to efficiency because it could also refer to time 	<ul style="list-style-type: none"> • “Less pollution. More eco-friendly modes of transportation.”

Appendix N:

Coding manual for expectations of future travel in the Story Survey

Coding Rules

1. If the code is present mark 1.
2. The number of times a code is present within each quote *is not* recorded. Only the presence or absence of the code is noted.
3. Each quote can contain multiple codes.
4. If an answer has conflicting views or multiple depictions of the future code for all.

Theme	Code	Description	Include	Exclude	Examples
Travel will use high carbon transport systems	High carbon transport	<ul style="list-style-type: none"> • References to vehicles or airplanes that ARE NOT more fuel efficient or use alternate fuels) • Reference to travel being the same as now (without becoming more fuel efficient) 	<ul style="list-style-type: none"> • Cars • Airplanes • Self-driving cars • Flying cars • Same as now 	<ul style="list-style-type: none"> • Alternatively fuelled self-driving cars • Alternatively fuelled flying cars • Responses that do not specify modes of transport 	<ul style="list-style-type: none"> • “Cars could hover metres off the ground.” • “Travel will be fairly similar to the way it is now. The types of vehicles may change but I can't for see any drastic changes.” • “...more of a focus on comfort and luxury, especially with plane travel.” • “I imagine that travelling will be relatively the same as current travel.”
	Increase in air travel	<ul style="list-style-type: none"> • References suggesting an increase in flying (either more people flying or people flying more often). 	<ul style="list-style-type: none"> • More flying • More airplanes • More airports • More people flying • People flying more often 	<ul style="list-style-type: none"> • Flying cars • Space travel 	<ul style="list-style-type: none"> • “More regional airports.” • “More airports and airlines

Theme	Code	Description	Include	Exclude	Examples
Travel will use low carbon transport systems	Use less fossil fuels	<ul style="list-style-type: none"> References to decreasing the use of fossil fuel References to vehicles becoming more fuel efficient Reference to using alternative fuel sources 	<ul style="list-style-type: none"> Increasing fuel efficiency Alternative fuel, Electric power Solar power Hybrid Bicycles Horses 		<ul style="list-style-type: none"> “...So probably riding in solar powered cars or maybe even hydro powered ones will become more mainstream.” “...Lots of bikes and walking. Maybe horses make a comeback?”
	Change in transport behaviours	<ul style="list-style-type: none"> references to transport that can accommodate many people at once (excluding airplanes and cruise ships) References suggesting a decrease in flying behaviour (either less people flying or people flying less often) References suggesting there are less cars being used or less individual ownership of cars 	<ul style="list-style-type: none"> Public transport Trains Hyperloop Carpooling Less flying Less airplanes Less people flying People flying less often Less cars Communal car ownership 	<ul style="list-style-type: none"> Airplanes and cruise ships as types of more sustainable mass transport Flying cars when referring to less flying 	<ul style="list-style-type: none"> “More public transport.” “Underground bullet trains?” “I hope people do not use planes as much because of the huge fuel cost and therefore cost to the planet.” “Minimal air travel” “Personal vehicles will be rare...” “Hardly anyone in developed countries will have drivers licences, most travel will be done by rail or self driving buses, cars are more niche...”
	Become more environmentally friendly	<ul style="list-style-type: none"> Any general catch-all phrase referring to travel becoming more sustainability that is not covered in any of the above categories. 	<ul style="list-style-type: none"> Eco-friendly Greener Less harmful to the environment More sustainable 	<ul style="list-style-type: none"> General references to efficiency because it could also refer to time 	<ul style="list-style-type: none"> “Somehow the same as now a days, but more eco-friendly.”

Theme	Code	Description	Include	Exclude	Examples
Travel will use systems that could reinforce high carbon systems	Faster travel	<ul style="list-style-type: none"> • Reference to travelling becoming faster • References to travel taking less time • References to trains/airplanes/cars that can travel at higher speeds • References to instantons travel (ie teleportation) 	<ul style="list-style-type: none"> • Faster • Time saving • Time efficient • High speed air travel • Bullet trains • Teleportation 	<ul style="list-style-type: none"> • Unspecified references to efficiency (because they could mean time or fuel) 	<ul style="list-style-type: none"> • “I think travelling in 2050 will be faster” • “Faster international travel (better jets).…”
	Space Travel	<ul style="list-style-type: none"> • References to recreational space travel • References to travelling is space as a means of getting from A to B faster 	<ul style="list-style-type: none"> • Space travel • Sub-orbital • Sub-space • SpaceX • Off planet • Interplanetary travel 		<ul style="list-style-type: none"> • “Space travel might be possible” • “Sub-space international Air travel for reduced time • Some interplanetary travel (moon &/or mars)
	Changes in travel	<ul style="list-style-type: none"> • References suggesting more people travelling • References suggesting people travelling further distances • References to that could increase the likelihood of travelling: travel becoming more affordable and more convenient 	<ul style="list-style-type: none"> • Travelling will be more frequent, • Increase in tourists/tourism • Travelling further • Less expensive • More affordable • Cheaper • Easy/easier • More availability • Less airport security • Less restricted • More options • Visa liberalization • Safer • Comfort 	<ul style="list-style-type: none"> • Speed 	<ul style="list-style-type: none"> • “I also guess we will travel more often and to further places, and it will be available to more people…” • “I think travelling in 2050 will be faster, more convenient, and more common.” • “People will be able to travel more, because it will cost less. • “More regional airports” • “Destinations previously thought of as remote will be more accessible …”

Theme	Code	Description	Include	Exclude	Examples
Travel will use systems that could reinforce low carbon systems	Slower travel	<ul style="list-style-type: none"> References to increased travel time 	<ul style="list-style-type: none"> Slower Take longer 	<ul style="list-style-type: none"> “Faster transportation, but people will probably take everything slower to relax because of a hectic lifestyle” 	<ul style="list-style-type: none"> “It will take longer to travel somewhere...” “Slower local travel”
	Return to older forms of travel technology	<ul style="list-style-type: none"> Reference to using travel technology that was around before the invention of the motor, References to old travel technology no longer in use References to returning to old travel technology. 	<ul style="list-style-type: none"> Bicycles Horses Zeppelins Walking 	<ul style="list-style-type: none"> Trains Cars Electric bicycles 	<ul style="list-style-type: none"> “Lots of bikes and walking. Maybe horses make a comeback?” “Zeppelin resurgence.”
	Changes in travel	<ul style="list-style-type: none"> References to that could decrease the likelihood of travel: travel becoming less affordable, less convenient. More local 	<ul style="list-style-type: none"> Harder More restricted Less safe Gridlock, Crowded Congested More expensive Less affordable Costs sky rockets More tolls More local Less travel Longer trips virtual (or mind) travel 	<ul style="list-style-type: none"> Speed 	<ul style="list-style-type: none"> “...less options to take luggage.” “... I also think there will be more restrictions on where tourists can go and how they get there. Especially at the tourist hotspots like monuments and old buildings.” “It will be more expensive, “...so the cost for those experiences (Machu Picchu) will sky rocket”

Appendix O:

Coding manual for key elements in the Story Survey

Coding Rules

1. If the code is present mark 1.
2. The number of times a code is present within each quote *is not* recorded. Only the presence or absence of the code is noted.
3. Each quote can contain multiple codes.
4. If an answer has conflicting views or multiple depictions of the future code for all.
5. If they say their opinion stated the “same” or something similar code everything as disagree.
6. If they are talking about electric or self driving cars but then mention that these cars will be communally owned, mark down as less driving

Theme	Code	Include	Exclude	Examples
Greater use of trains and public transport	1a) Agree	References to: <ul style="list-style-type: none"> • More trains/ more people using trains, • More high speed trains/ more people using high speed trains • More bullet trains/ more people using bullet trains • More public transit/ more people using public transit • More buses/ more people using buses • More multi-person vehicles • More communal travel 		“Increased public/ self driving transit.” “More electric, self-driving, multi-person vehicles that pick up and drop off multiple people as they need to be ferried around using an automated system.” “Public transport options will be more readily available and thus used.”

Theme	Code	Include	Exclude	Examples
More Bicycling	1b) Disagree	References to: <ul style="list-style-type: none"> Less trains/ less people using trains, The same amount of trains/ the same amount pf people using trains Less public transit/ less people using public transit Same amount of public transit/ same amount of people using public transit Less buses/ less people using buses Same amount of buses/ same amount of people using buses 		<p>“...take the rare forms of public transport still running (buses or trains).”</p> <p>“In small centres public transport still won't be improved as there won't really be a demand for it, so people will still be using cars.”</p> <p>“Same slow transport on buses and planes.”</p>
	2a) Agree	References to: <ul style="list-style-type: none"> more bicycling/cycling more people bicycling/cycling 		<p>“Lots of bikes and walking.”</p> <p>“Also more common to take trips by bicycle or electric bicycle.”</p> <p>“Revert to bicycles”</p>
	2b) Disagree	References to: <ul style="list-style-type: none"> less/same amount of bicycling not agreeing that there will be more bicycling 		<p>“I don't think it's realistic to expect people to go back to bicycles.”</p>

Theme	Code	Include	Exclude	Examples
Less Driving	3a) Agree	References to: <ul style="list-style-type: none"> less people driving less people owning cars/ personal vehicles more communal ownership of cars/ personal vehicles cities being car free 	References to people switching to: <ul style="list-style-type: none"> electric cars/ personal vehicles alternately fuelled cars/ personal vehicles 	“Not as many cars or petrol vehicles.” “Cities will move towards being car free.” “Communal ownership of vehicles”
	3b) Disagree	References to: <ul style="list-style-type: none"> fossil fuel cars/ personal vehicles electric cars/ personal vehicles alternately fuelled cars/ personal vehicles flying cars self-driving cars improved highways 		“Flying cars” “Hopefully better highway systems” “I believe there will still be motorized vehicles but whether they're man driven or not is another question” “The majority of cars will run on clean energy.”
Flights are expensive	4a) Agree	References to: <ul style="list-style-type: none"> flying becoming more expensive air travel becoming more expensive 	References to: <ul style="list-style-type: none"> budget airlines travel in general becoming more expensive 	“I think air travel will be prohibitively expensive,” “More expensive to fly.”
	4b) Disagree	References to: <ul style="list-style-type: none"> flying becoming cheaper Flying becoming less expensive air travel becoming cheaper air travel becoming less expensive more budget airlines 	References to: <ul style="list-style-type: none"> travel in general becoming cheaper/less expensive 	“Flying will cost lower.” “Less space on planes, cheaper tickets” “Cheaper air [fares].”

Theme	Code	Include	Exclude	Examples
Less flying	5a) Agree	References to: <ul style="list-style-type: none"> less people flying people flying less often less flights more people per flight 		<p>“Less chance of air travel.”</p> <p>“Fewer plane flights”</p>
	5b) Disagree	References to: <ul style="list-style-type: none"> more people flying people flying more often more flights planes/flying without a mention of reduction of flying 		<p>“More flights,”</p> <p>“Faster planes”</p>
Less international/ more local travel	6a) Agree	References to: <ul style="list-style-type: none"> less international travel less people travelling internationally people travelling internationally less often more local travel more people travelling locally travelling shorter distances 	References to: the term local travel as a term to describe how people are travelling travel (example international travel will be xxx while local travel will be yyyy)	<p>“Less international travel”</p> <p>“More people will travel in their own country.”</p> <p>“search for closer destinations”</p> <p>“More possibility for local (domestic) trip.”</p>
	6b) Disagree	References to: <ul style="list-style-type: none"> more international travel more people travelling internationally people travelling internationally more often traveling further 		<p>“International travel will be on mass”</p> <p>“international travel will be cheaper and more accessible than ever before”</p>

Theme	Code	Include	Exclude	Examples
Slower travel	7a) Agree	References to: <ul style="list-style-type: none"> • travelling slower • slow travel • 	References to: <ul style="list-style-type: none"> • modes of transportation that would cause you to travel slower (cycling, walking) without the direct reference to them being slow 	“Slower local (bikes)” “slow travel like walking and bicycling.”
	7b) Disagree	References to: <ul style="list-style-type: none"> • travelling faster • bullet trains • high speed trains • concord planes • teleportation 	References to: <ul style="list-style-type: none"> • general efficiency (because they could be time or fuel) 	“Quicker and cheaper.” “I think it will be faster and more efficient.”

Appendix P:

Coding manual for interviews

Coding Rules

1. If the code is present mark 1.
2. The number of times a code is present within each quote *is not* recorded. Only the presence or absence of the code is noted.
3. Each quote can contain multiple codes.
4. If an answer has conflicting views or multiple depictions of the future code for all.

Theme	Code	Description	Include	Examples
Text recall	Yes	Can accurately recall at least one detail of the text even if there is also misinformation in the recollections	<ul style="list-style-type: none"> • Facts about the text • Underlying text messages 	“We should take more time to travel or we should accept more, you know, inconvenience rather than, you know, trying to get to the destination faster”
	No	Cannot recall anything from the text	<ul style="list-style-type: none"> • Cannot answer the question • Only provide examples that were not in the text 	
Barriers to engaging in low carbon mobility		Reasons why participants have been unable to engage in the forms of low carbon travel that they would like to be engaging in.	<ul style="list-style-type: none"> • Safety concerns • Lack of infrastructure • Inconvenient • Large distances • Time/ speed • Weather • Cost 	“I wish I could bike more but in [this city] the bike system isn’t really well developed. I don’t think. I don’t feel safe on the roads.”

Theme	Code	Description	Include	Examples
Behaviour change	More low carbon travel	References to changing their travel behaviour to engage in more low carbon travel	<ul style="list-style-type: none"> • Less international flying • More local travel • Less car use • Driving an electric car • More public transport • More walking • More cycling 	"I take the bus...in New Zealand I couldn't take the train but, ya, in Germany [I] quite often take the train."
	Less low carbon travel	References to changing their travel behaviour to engage in less low carbon travel	<ul style="list-style-type: none"> • More international flying • Less local travel • More car use • Less walking • Less cycling • Less public transport 	"So unfortunately I have changed the way I travel 'cause I used to cycle to work everyday, and I'm pregnant now and so I am not cycling anymore."
Thinking	Thinking about low carbon mobility for the first time		<ul style="list-style-type: none"> • Never thought about it before • Made me think about what could happen 	"Made me think beyond the current situation to what the future scenario might be."
	Changed how they thought about travel		<ul style="list-style-type: none"> • More aware of the environmental impacts of travel • Thinking that the travel industry is changing to become more environmentally sustainable • Thinking that travel might be different than they originally thought 	<p>"It does actually seem to be heading in a worthwhile direction. I feel like a short time ago I thought it was total distraction and was not like ever going to have any effect but now I'm thinking maybe it's having 1% effect which is heaps, heaps better than the zero I had in mind"</p> <p>"I've changed in that I think there are more interesting things to do locally"</p>

Appendix Q

Participants mentioning or contradicting key elements

Total number of key elements mentioned or contradicted by participants before and after interventions

	Number of Key Elements	Mentioned				Contradicted			
		Before		After		Before		After	
		N	%	N	%	N	%	N	%
Story group	0	137	82	118	71	72	43	99	59
	1	18	11	27	16	67	40	49	30
	2	10	6	12	7	19	11	16	10
	3	2	1	5	3	9	5	3	2
	4	0	0	3	2	0	0	0	0
	5	0	0	2	1	0	0	0	0
Textbook group	0	137	75	112	61	89	49	115	63
	1	26	14	36	20	69	38	45	25
	2	14	8	26	14	17	9	18	10
	3	5	3	6	3	8	4	4	2
	4	1	<1	2	1	0	0	1	<1
	5	0	0	1	<1	0	0	0	0

Number and percent of participants who changed the number of key elements mentioned or contradicted following the story and textbook interventions

Intervention	Change	n	Percent
Story (n = 167)	Key Elements Before > Key Elements After	16	10
	Key Elements Before < Key Elements After	33	20
	Ties	118	71
Textbook (n = 183)	Key Elements Before > Key Elements After	15	9
	Key Elements Before < Key Elements After	54	30
	Ties	114	62
Story (n = 167)	Contradicts Key Elements Before >	53	32
	Contradicts Key Elements After		
	Contradicts Key Elements Before <	30	18
	Contradicts Key Elements After		
Textbook (n = 183)	Ties	84	50
	Contradicts Key Elements Before >	60	33
	Contradicts Key Elements After		
	Contradicts Key Elements Before <	22	12
	Contradicts Key Elements After		
	Ties	101	55

